The APL Jot·Dot·Times

Spring 1985 ∘.× A Product of Kingston APLSV

EVERYTHING you ever wanted to know about APL Security

...plus 234 additional bonus pages!

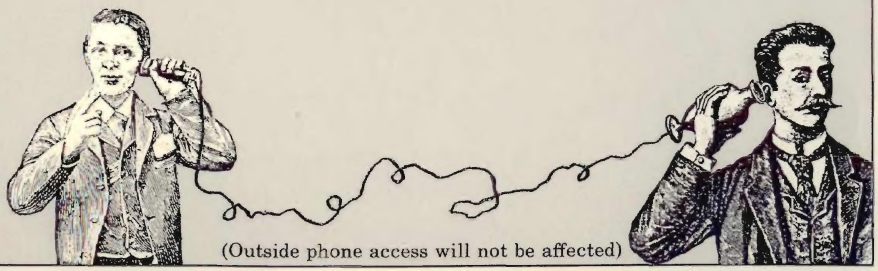
NOTICE

regarding phone calls to Kingston, using the IBM internal tie-lines

●

Effective 01 June 1985, the tie-line phone access for the entire Kingston IBM site will change from "373-" to "695-".

- ☎ If you call The APL Hotline *before* 01 June 1985, use T/L 373-1234.
- ☎ If you call The APL Hotline *after* 01 June 1985, use T/L 695-1234.



(Outside phone access will not be affected)

The APL Jot•Dot Times

A Product of Kingston APLSV
(Published Sporadically)

—Special APL Security Issue—

Some production notes

The text for this newsletter was entered on an APL-featured 3279 display terminal, and composed using Script. The master pages were then printed on the IBM 4250 electro-erosion printer [a 600-pel matrix printer].

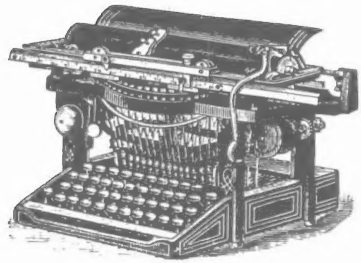
The illustrations scattered throughout the newsletter (including the cover) were created between 1850 and 1925, originally appearing in newspapers, advertisements, and periodicals. The particularly astute amongst you may notice that many of the old engravings have been *slightly* retouched (using a 5¢ Gem razor blade and some Scotch tape).

Jon

—Jon McGrew
Wordsmith

Cover Portrait: Everyone tells you to write "bullet-proof code", but no one seems to tell you *how* to do it. *We* will.

Preface



"What Ever Happened to the Jot◦Dot Times?"

WE HEAR THAT QUESTION all the time. Well, first of all, we should point out that we *are* still on schedule. Realize that every issue of Jot has stated that it is "published sporadically," and we certainly don't want to break with tradition now.

For those of you who may consider that answer to be a bit too flippant (and who wouldn't?), we'll offer another defense. We would dearly love to be able to publish the Jot◦Dot Times on a frequent basis. And, no —contrary to some opinions which have been voiced— we haven't been this long because we didn't have anything to say (...those of you who know us, know better). What we have been short of is *time* and *manpower*... but then, who isn't?

One of our projects which took a big chunk of time was the publishing of a user's guide for the new APL2 Program Product. If you are interested in such things, you can order *"An Introduction to APL2"* (SH20-9229) from the Mechanicsburg or Copenhagen distribution centres. That was our interim Jot◦Dot Times. ...So you see, we really *have* published another issue— old engravings and all.

Another delay in getting material published was simply the difficulty in dealing with the mechanics of printing the final camera-ready copy for the manuals. All of the previous issues were done on —believe it or not— a Selectric terminal [remember those?], but they are slow and aged... and in a much lesser state of health than they were years ago. We sorely needed better production methods and tools, while still being able to maintain a high calibre of print quality. We think that we have finally found the right approach with the IBM 4250 printer, which was used to print this manual. [For those of you who have never heard of that printer, it's a matrix printer with *lots* of dots.] We hope that you will like our new look. [Gee, this is just like the *big* companies do it!]

> "You complain, friend Swift, of the length of my epigrams, but you yourself write nothing. Yours are shorter."
>
> —Epigrams I, 110
> by Marcus Valerius Martialis, A.D. *c* 40 – *c* 104

Balking at Bulk

Realize that the history of the Jot◦Dot Times has been to make each new issue larger than all previous issues *combined* (not really intentionally; it just happens that way). For better or for worse, we once again came frighteningly close to that pattern.

Realize also that the production of The APL Jot◦Dot Times has been handled by a staff of one for as long as it has been published (since 1977). And unfortunately, other projects often (usually) have to come first, to the exclusion of our newsletter. For example, *we* had to meet the Corporate Security requirements.

The result of all of that is that one of the most frequently-asked questions about our newsletter is, "How come I didn't get the last issue of The Jot◦Dot Times? Am I still on your mailing list?" Well, you can see now that you evidently *are* still on our mailing list. The reason that you haven't gotten a recent copy is that we haven't published one since (*gulp!*) the Summer of 1981 [the Mailbox issue]. Another common question is, "How can I get all of the back issues of Jot?" Unfortunately, we can't be of much assistance here; we have few remaining back issues of Jot◦Dot Times.

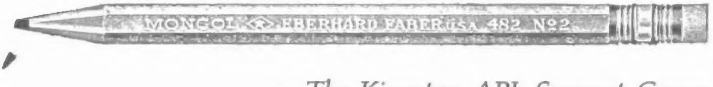
Presenting the All-Time Least-Read Issue of the Jot◦Dot Times

Okay, we know that Security isn't necessarily your favorite subject. But we (as the suppliers of service) have a requirement to show you the ins-and-outs of the various security items on APL. Corporate Security Instruction #104A (*the definitive* word on IBM Security), states, "Suppliers of services must effectively communicate to owners and users available control facilities, recommended practices, and installation rules and restrictions" [page 155]. If we're going to do that at all[1], we're going to do it right.

Finally, while people often balk at the idea of reading about Security, a *much worse* position to be in is to be required to comply with rules that you have never seen... and further, to not have any information on how to implement the required security measures.

We value your thoughts on this newsletter. If you have any comments or suggestions regarding either the newsletter or our service, please let us know. There is a Reader's Comment Card folded inside the back cover of this newsletter.

Your comments can often help to mold future issues and future offerings on APL. Many of the facilities that we have offered in the past are a direct result of comments that were sent in by newsletter readers. Please, let's hear from *you!*



—The Kingston APL Support Group

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1 We are.

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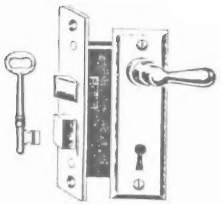
Introduction



Security: It's not just for break-ins anymore

The term "security" is generally understood to apply to methods of controlling access to information. In a broader sense, it must also include methods of preserving the integrity of data and protecting resources. Additionally, normal on-going business management control —knowing where your money is going— is a consideration in the use of any system.

Many features of the APLSV system are provided to preserve the integrity of your work and data. These are automatically invoked by the system. For applications which require a higher level of security, other features are available which are invoked by following specified procedures. This booklet discusses both system and application security features and their uses. We provide this information in the hope that you will be able to provide users of your applications with security measures which would be seen as being very secure by an informed user.

Although this booklet is intended to be comprehensive, it is not exhaustive.[3] For very sensitive applications, you may want to consider additional security steps beyond the items shown here. We are always available for discussions of such matters.

Here Today; Here Tomorrow

Security is an ever-present issue. It probably comes as no news to you that Corporate Security tightens the requirements for controlling data on time-sharing systems a bit more each year. This booklet has three main purposes:

- To detail the security *requirements* which Corporate Security requires *you* to meet,
- To explain the security *features* which we provide for your use here on Kingston APL, and
- To explain the steps that we take for you, to help to protect your data.

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3 ...other than physically, perhaps.

For the NON-Programmers Amongst You

We often hear comments from our various customers, saying that "I'm not a programmer; I'm not even sure how to *spell* 'APL'!" Don't worry; you're in good company. We realize that most of the users of the Kingston APL system are *not* programmers. Our best estimate is that only about 15% of you do any APL programming at all. The first three sections of this booklet give general information regarding the security requirements that all of the users are required (by Corporate) to meet. Additionally, if you have any TSIO datasets on the system, a later section explains in detail each of the security requirements that come with that territory.

For the Programmers Amongst You

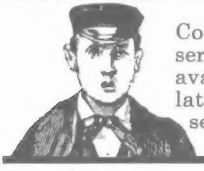
The remainder of this booklet—which is the greater portion of it—deals with all of the details of programming which can separate the somewhat secure applications from the very secure ones. Lots of detail is given so that you can use the portions that you need as a reference manual. For those portions which discuss programming details, we of course assume that you are already an APL programmer. If you are *not* already a programmer, this booklet will *not* teach you programming. That's not our intent here. If the details of operations that are shown here make you realize that you need some background before you can make use of this manual, we recommend that you refer to "The APLSV Version 3 User's Guide (SH20-9087)" and "The APL Language Manual (GC26-3847)". Additional references are available in the back of this booklet.

At the end of this booklet are complete copies of two important Corporate Security documents. The first one is *Corporate Security Instruction #104A* (form number ZE22-7020). The other one is *Information Classification and Control* (form number ZZ00-0001). Additional copies of either of these documents may be ordered from the Mechanicsburg and Copenhagen Distribution Centres, in the same way that you would order any IBM manual. Both are also available on-line in workspace "`10 DOC104`". Entries which appear in italics in the index refer to those documents.

Here Come the Excuses....

We've heard them all. "Security isn't my job." "It's tedious and boring to discuss that stuff." "Security is too time-consuming." "Those documents are filled with crazy requirements." ...Well, when's the last time that you read—no, *really* read—the Corporate security requirements? The early requirements, many years ago, were attacked for not being relevant to interactive systems (such as APL) and for being "un-meetable." So Corporate took these complaints to heart, and the new requirements *are* both relevant and reasonable. And they ***will*** be enforced by Corporate.

Don't Shoot the Messenger!!



Corporate Security Instruction #104A requires that "Suppliers of services must effectively communicate to owners and users available control facilities, recommended practices, and installation rules and restrictions" [page 155]. As the suppliers of service for Kingston APL, we are required to both advertise and

meet these security requirements. If you have disagreements with the various requirements, please at least realize that we didn't invent the rules, and perhaps take solice in the understanding that *we* have had to meet all of the rules, too. ■

Who Ya Gonna Call??

If you have any questions regarding your use of Kingston APL, please contact:

Kingston APL Support

63C 385, Neighborhood Road, Kingston, NY 12401

☏ T/L 695-1234 or 914-385-1234 ☎

IBM internal systems must be used for
IBM management-approved purposes only.

●

"IBM Confidential Restricted"
is the highest security level supported
by Kingston APL.

Section 1: Keeping Current

Using workspace 1 *NEWS*

This document is our attempt to explain all of the current security features and requirements—but "current" is a key word here. Requirements change; all we can do is pass the word along. And new features are added periodically, but they are of little use if you don't know about them.

We of course always have the option of mailing memos and documents (like this) to all of our users. But with thousands of Kingston APL users world-wide, that's slow and expensive. For keeping up-to-date with changes as they occur, our prime means of contact with you is through `1 NEWS`.

Unfortunately, some of our users never look at `1 NEWS`. When time-saving features are developed, they are the last to know. And when new security requirements are passed down to us from Corporate, they may be sufficiently late in hearing about them that they are in "catch-up" mode.

Workspace `1 NEWS` is probably the only really universal APL workspace. It is installed on nearly all APL systems (from all companies). While it may take on quite different forms on different systems, it is still *the* recommended means for hearing the latest news about your system. On Kingston APL, we have set it up so that it will only take a few seconds to check it if there doesn't happen to be any news, and just a little bit longer if there *is* some news [...how fast can you read?]. And once you have seen a news item, you won't be prompted for receiving it again. But all of this is for naught if you don't ever check the news.

We *strongly recommend* that you

)*LOAD* 1 *NEWS*

each day that you use APL.

■

Analyzing the Security of the APL Mailbox

Sometimes it's instructive to analyze a sample application to see the types of approaches that may be used. The APL Mailbox (in workspace `1 NEWS`) is an application with what we consider to be rather tight security.

Sending Your Own Messages

As well as providing the function of delivering our news messages to you (as its name suggests), workspace `1 NEWS` also provides a means of letting you send your own messages to anyone else on the system. We realized some time back that a news facility is really just sort of the junk-mail equivalent of a proper mail facility– it's the portion that delivers the mail to "Occupant". So we generalized it. It is now a full-function mail facility, with provision for setting up distribution lists, specifying release dates and expiration dates, using "carbon-copy" notations, and pretty much whatever else you need to communicate with the other Kingston APLSV users. It's particularly helpful when the person that you're trying to contact is in a different time zone or overseas.

To send a message to another user, just type "*SEND*", and you will be prompted through the necessary steps. *At any point* in the Mailbox where you need some assistance, just type a question-mark. There is quite a bit of "help-text" built in.

Along With the Extra Capabilties Comes Concern

When we started to offer these increased capabilities, we of course had a lot of concern about being sure that mail couldn't do astray. There should be *no way* that any user can print any message except the ones that he created and the ones that have been sent to him. If you were ever to be given the feeling that someone was monitoring your mail, chances are you would never feel comfortable with it, so we wanted to do everything that we could to ensure complete privacy for the mail.

During the design of `1 NEWS`, we spent quite a bit of time reviewing security problems and solutions. The more we looked, the more potential loop-holes we found. That's partly what led to this newsletter. So, let's just review the steps that we took for ensuring the confidentiality of the Mailbox application, and see if any of these points may interest you. All of them are covered in detail in this manual.

1. Obviously, the Mailbox itself has to ensure that you can't print anyone else's messages just by using the commands in the Mailbox. Therefore,

   a. `⎕AI` is read by the Mailbox to know who you are. This is then correlated to your "mailcode".

   b. A copy of your mailcode in stored in the message header, as a double-check when the message is retrieved. Pointers are used to locate your messages quickly and efficiently, but before you are given a chance to see any message, the system checks to ensure that your mailcode appears in either the "to" or "from" lists. If there's any descrepency,

that would indicate a bug in our code, so the pertinent details of the problem would be logged in a dataset for us to investigate further.

2. All of the functions in the Mailbox are locked.

3. Local variables *and functions* are used throughout the code (using a function file). In this manner, some of the critical functions aren't even in the workspace, so it's that much harder to tamper with them.

4. Execution of the code is initiated by the latent expression (*□LX*), and the code cannot be re-started manually. When the workspace is loaded, it resets the latent expression and re-assigns another global variable.

   If you interrupt the latent expression before it has been executed and changed, the other global variable hasn't yet been set, so the code can't be re-started. If you execute the latent expression and wait until the global variable has been set, the latent expression is no longer valid.

   These checks of course don't constitute a very secure procedure by themselves, but they help, and since the user wouldn't know what the global variable is, or what its value is supposed to be —or even that such checks are taking place— it's one more bit of protection.

5. The *OPEN* function looks at the value of *□LX* and the global variable to see if they are set to appropriate values. If they are not set properly, the possible attempted mis-use is logged.

   a. That *OPEN* function is one single stand-alone locked function, so it's not possible to see what it is doing internally.

   b. If the code determines that a user has loaded the workspace, interrupted the exeuction, and tried to tamper with the *OPEN* function, it logs the problem *instead* of opening the mail file.

   c. The *OPEN* function also looks at the values of several other variables in the workspace —which should be local to its calling function— to ensure that it is being called from within the proper function.

6. The workspace is stored in a restricted library, so that no one can save a copy of the workspace in their own account and have it sent to another system to examine the code. This is one of the most important security steps of this facility.

7. The mail is stored in a reserved dataset, so users must go through a command dataset in order to be authorized to access it.

8. The command dataset issues an *IRW* command with "universal access" (anyone can use it). Therefore, to further protect that, pseudo-passwords are used through symbolic parameters in the indirect commands.

9. The Mailbox's dataset is protected from batch access by RACF —as are all of the TSIO datasets on the system, by default, unless you explicitly take steps to over-ride it.

10. All of the functions in the Mailbox are protected by several levels of dyadic execute, to protect any messages that you may be in the process of entering, just in case you press **ATTENTION** (or **PA2**), or in case there's a bug in the code. [Is that possible??]

11. The unlocked maintenance copies of the functions for the Mailbox are kept in a locked workspace.

    a. That workspace is protected by a non-trivial password.

    b. That password is changed periodically.

12. The text of any Mailbox message that you send is scrambled when the message is stored on the file. This is the final protection, just in case someone manages to sneak a peek at the file. Therefore, simply getting access to the file by any means other than through the functions that have been provided in `1 NEWS`, will tend to be fairly useless.

●

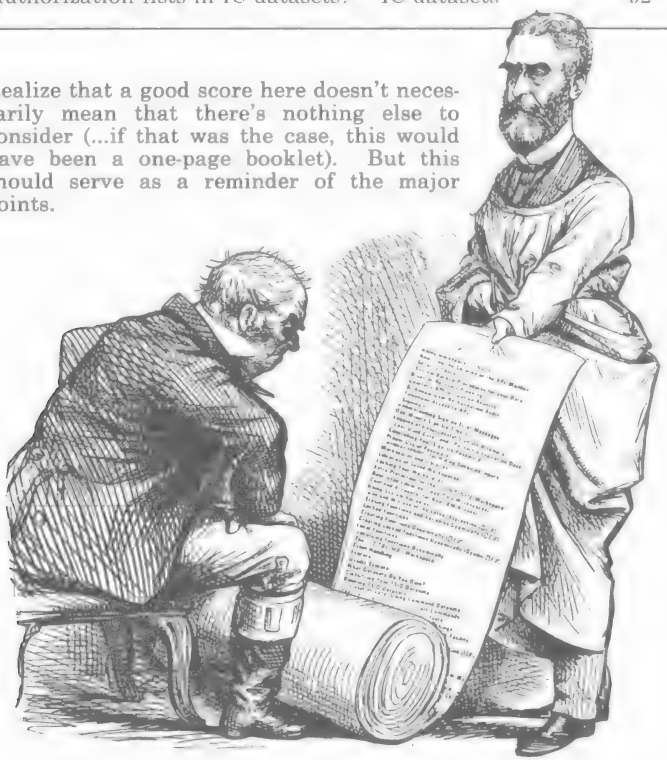
Throughout the rest of this newsletter, we will be discussing these points and many others, to demonstrate exactly how to protect the applications and data that you consider to be sensitive. ■

Security Check-list

Here is a list of items which you should check to ensure the security of your applications. Rate yourself.

		Reference	Page
Have you:			
☐	Changed your sign-on password regularly?	passwords	28
☐	Chosen a non-trivial sign-on password?	passwords	31
☐	Locked workspaces having sensitive data?	workspace locks	39
☐	Checked to see what datasets you own?	workspace `1 FILELIB`	73
☐	Classified all of your datasets?	*CLASSIFY* function	79
☐	Used reserved datasets for confidential data?	dataset privacy	85
☐	Reviewed authorization lists in IC datasets?	IC datasets	92

Realize that a good score here doesn't necessarily mean that there's nothing else to consider (...if that was the case, this would have been a one-page booklet). But this should serve as a reminder of the major points.



System Backup Procedures for Your Data

When you "*)SAVE*" your workspaces and write your data to TSIO datasets, it is presumably permanently stored. But everyone knows that hardware isn't infallible; how do we ensure that this information is protected and there when you need it, even if the hardware fails? ...We ensure it by planning ahead and by taking steps every day to recover from the problems which we all hope will never occur (...with luck, this will be "wasted" effort!).

APLSV Workspaces

APLSV shuts down each night for workspace and file maintenance, typically from midnight to 2:00 am on Tuesdays through Fridays.[3] During this nightly maintenance, copies of all of the workspaces that were "*)SAVE*d" during the previous day are written out to tape. This is an "Incremental dump" of just those workspaces which have been changed. These tapes are saved for two weeks, and then re-used.

Every Saturday morning, from 2:00 am to 7:00 am, a "Full dump" is run, in which *all* of the workspaces on the system are copied onto tape, whether they were "*)SAVE*d" during the previous week or not. These tapes are kept for twelve weeks before they are re-used. After they are two weeks old they are sent off-site, and kept off-site for four weeks.

Finally, four times a year we run our Quarterly Backup, which copies *all* of the workspaces onto tape. These quarterly tapes are kept for two years before they are re-used. All of the quarterly tapes are kept on-site.

Notice that the Password Change chart on page 30 points out that APL accounts are only actually deleted at the end of a quarter. That schedule is based upon this backup scheme, wherein workspaces may be recovered up to two years after the account has been deleted. Notice also that the chart shows that the account is locked for some period of time preceding the deletion, which prevents the workspaces from being used or updated before the account is deleted.

TSIO Datasets

Since Kingston APL is a highly interactive system with many millions of updates to the data occurring daily (literally), our intent is to copy all of the TSIO datasets onto tape every night. With the volume of data to copy and the amount of other work to be done each night, this desired goal cannot always be met. If you consider your application to be critical, and need to guarantee daily backup for it, please let us know of your needs.

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[3] Kingston APL typically runs about 22 hours a day, seven days a week. This schedule is an approximation of our normal schedule for discussion purposes. Exact schedules – including any intermittent schedule exceptions– are always available and kept up-to-date on APL... "*)LOAD 1 NEWS*" and type "*SCHEDULE*".

Every Monday through Thursday, datasets are copied to tape during the evening; these tapes are kept for one week. Each Friday the datasets are copied to tape and kept for four weeks, with the newest and oldest being kept on-site, and the middle two weeks being kept off-site.

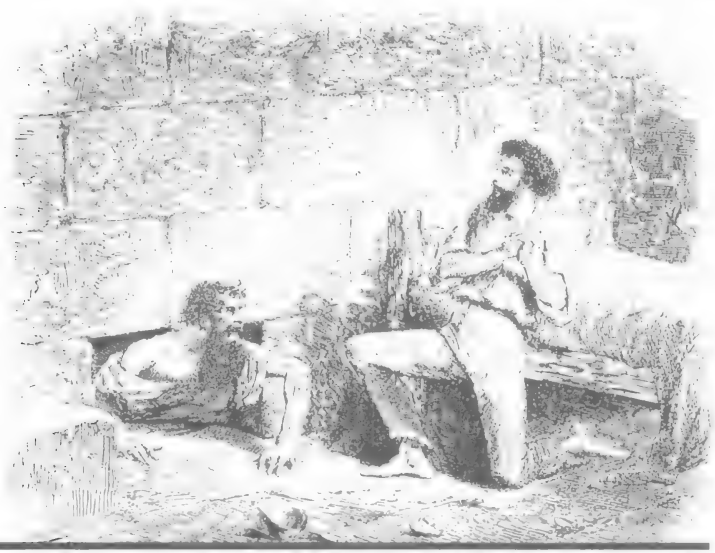
On-Site versus Off-Site Storage

We have been discussing the idea of sending tapes off-site for storage; perhaps we should discuss *why* we do that. We would like to keep everything on-site, right in our own tape libraries, so that it's available for you if you need to have some data recovered. But what happens if there is a disaster, such as perhaps a fire or explosion, which damages or destroys our tape library?

To plan for such contingencies, we regularly send copies of workspaces and datasets to an off-site underground storage facility, whose entire function is to store and protect data against the most dire of circumstances whatever that may be. The entire point of all of this is to make sure that your data is available for your use, come what may.

Recovering Data from Underground Storage

Backing up all of that data would be an exercise in futility if we didn't have a reasonable means for you to get it back. Apart from natural disasters, fires in the machine room, and even our own hardware failures, there are cases that occur all the time which put that backup data to use. It's certainly not unheard of for people to accidentally delete or accidentally overwrite their own datasets. If this happens to you, ***don't panic!*** Just give us a call at T/L 695-1234, let us know whether it is a workspace or a TSIO dataset that you need to have recovered, and give us its account number and name. As long as it has been there overnight, it should be recoverable. ■



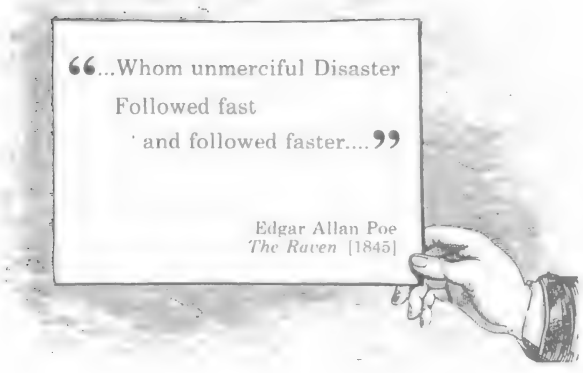
Disaster Recovery Planning

Kingston APL has made arrangements to establish service at another IBM site in the event of a large-scale disaster that would prevent the Kingston site from being used. Tests of this operation, simulating actual disaster recovery, are conducted once a year.

Workspaces would be recovered from the most recent "Full dump" tapes.

It should be understood that we cannot necessarily restore *all* of the TSIO datasets on another machine following an actual disaster, due to the massive quantities of storage involved. This would of course impact some users since all datasets would not be available on line. Some of the users would have to wait until more permanent arrangements were made. In that event, any decisions as to which datasets or applications would be available would be based upon business needs at the time of the recovery.

Realize, though, that we are discussing here the recovery from a major disaster —a large-scale fire, explosion, tornado, and so forth— of a magnitude that would prevent us from continuing operations in Kingston. Obviously the main direction in recovery is to get operations restored at the Kingston site as quickly as possible. ■



Section 2: Periodic Mailings and Responsibilities

Kingston APL sends reports out periodically to those of you who have accounts (sign-on numbers) on the system and to those of you who are paying for the service. Some of these reports are for information only; some of them require a reply. This section will explain what it is that we mail, and why.

Quarterly APL Utilization Reports

Four times per year (at the end of each quarter), we mail an APL Utilization Report to the billing manager of each user on the system. This report has three main purposes: to show the manager *who* is accessing our system under his problem number, *how much* usage they have accumulated (for asset control, budget, and planning purposes), and which users have *not* classified their files, per Corporate Instruction 104A.

The manager who receives the report should ensure that all of the users shown are still in his group. If there is any error in the administrative information that we show, please notify us promptly, using the change form that we include at the end of that report.

Ideally, if the reports can be distributed to the appropriate APL users after reviewing the data, it may help them to track their own usage.

These reports are sent for information only, and do not require any action on your part when you receive them; no reply is needed. However, please do not confuse this with the bi-annual audit forms that we send out; those *do* require a response. ...We'll discuss those next.

Here is a sample of the Quarterly Utilization Report:

SAMPLE REPORT
Printed 09/25/84

KINGSTON *APLSV* RESOURCE UTILIZATION
Report covers 06/23/84 - 09/21/84
(Mid-Hudson Accounting weeks 27-39)

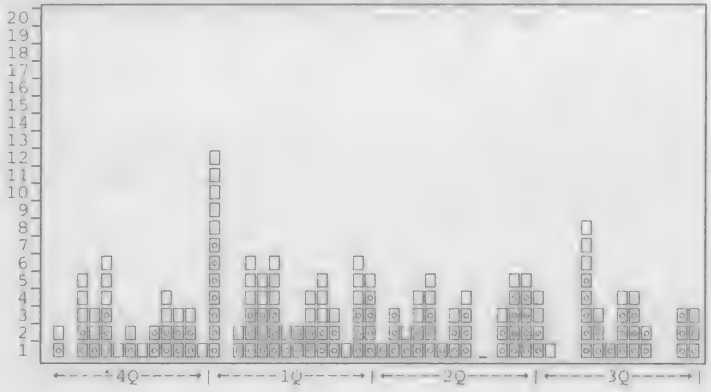
PROBLEM NUMBER 123XAK
BILLED TO: J DOE, 123 003-1, ATLANTA, GA (RECD) 8-555-2468

123456 *MJSMITH* J SMITH, 123 003-1, ATLANTA, GA (RECD) 8-555-1357

End	←Time in HH.MM.SS→		DASD	←Cost→			
Dates	Connect	Compute	Tracks	Connect	Compute	Storage	Total
06/29	5.25.00	0.03.31	3	$23.56	$39.04	$.03	$62.63
07/06	3.44.00	0.02.15	3	$16.24	$24.98	$.03	$41.25
07/13	0.36.00	0.00.25	2	$2.61	$4.63	$.02	$7.26
07/20			2			$.02	$.02
07/27			2			$.02	$.02
08/03	7.30.00	0.04.30	3	$32.63	$49.95	$.03	$82.61
08/10	3.12.00	0.01.48	3	$13.92	$19.98	$.03	$33.93
08/17	1.28.00	0.01.16	4	$6.38	$14.06	$.04	$20.48
08/24	4.13.00	0.02.52	3	$18.34	$31.82	$.03	$50.19
08/31	4.24.00	0.03.12	3	$19.14	$35.52	$.03	$54.69
09/07	1.56.00	0.01.56	3	$8.41	$21.46	$.03	$29.90
09/14	3.28.00	0.02.36	2	$15.08	$28.86	$.02	$43.96
09/21	3.20.00	0.02.02	2	$14.50	$22.57	$.02	$37.09
	39.16.00	0.26.23		$170.81	$292.87	$.35	$464.03
[YTD]	139.28.00	1.22.52		$576.25	$919.85	$1.19	$1,497.29

Sign-on password last changed 09/21/84; it MUST be changed by 11/23/84

P A S T Y E A R A T A G L A N C E



LEGEND:

□ Connect hours
◦ Compute minutes

[Prepared and printed on *APLSV*] 123XAK

Bi-Annual User Re-Validation Audit

In operating a world-wide service like Kingston APL, we of course need to know *who* our users are, and to be able to get in touch with them; good business practices dictate that we keep this information current.

Furthermore, Corporate Security Instruction #104A requires that "Authorization to use IBM's information processing facilities and services must be revalidated periodically and deactivated upon notice of termination of the user's business need" [page 157].

Twice a year (during February and August), we send out a User Re-Validation Audit form to each user, which needs to be reviewed, have changes to mailing address marked, be signed by the user *and* his manager, and returned to us.

When this report is sent out, you will generally have two months in which to return it. We provide such a long time to try to cover all of the special situations that may arise, such as a user being on an extended vacation, or a user in Japan with a manager in Germany.

We strongly recommend that you return these forms promptly when you receive them. Since it is a Corporate requirement that we audit our users, we must enforce the return of the forms. The only means we have of enforcement is to lock offenders out of APL if the forms aren't returned within the allotted time. We don't like to take this step — we realize that we are simply a service group and that you need to get your job done — but that's our only means of enforcing the Corporate rules.

Here is a sample of the Bi-Annual Audit form:

Kingston APLSV --- August 1984 APLSV Administrative Audit Form

Account Number/Name: 123456 *MJSMITH* Billed to Problem-Number 123XAK

DO NOT WRITE INSIDE THIS BLOCK

NEW PROBLEM NUMBER _____	OLD PROBLEM NUMBER _____
FILE COPY _____	DIRECTORY _____
SYSTEM (ADMINLOCK) _____	PROFILE _____

Return to: IBM Corporation, APL Administration,
63WD 220, Kingston, NY 12401 (T/L 695-1234)

If form is NOT returned, user will be DENIED ACCESS to Kingston APLSV
Return REQUIRED no later than October 1, 1984

☐ Check here if this account is to be DELETED from Kingston APLSV
(Caution: Only if the account is no longer in use)

☐ Check here if all information is correct
(Signatures still required)

...If incorrect, please *PRINT ONLY THE CHANGES* below:

User's Information:

First and Last Name ..... JAY SMITH
IBM Zipcode 123 603-1
Mailing Address ..... ATLANTA, GA

IBM INTERNAL MAIL

Division 26 D4D
Tie-line and extension ... 695-1457 T L 8- - -
Employee's serial number . 123456

Employee's signature: _____ Date: _____

...If incorrect, please *PRINT ONLY THE CHANGES* below:

Manager To Be Billed:

First and Last Name ..... JOHN DOE
IBM Zipcode 123 603-1
Mailing Address ..... ATLANTA, GA

IBM INTERNAL MAIL

Division 26 D4D
Tie-line and extension ... 695-1465 T L 8- - -
Manager's serial number .. 112233

Manager's signature: _____ Date: _____

■

Section 3: Protecting Your System Sign-On

Telephone Access to APL

If you are one of the twenty-percent of our users who use dial-up terminals instead of 3270 display terminals, you will need to understand how we control the telephone access into our system.

Kingston APL has local phone numbers available at many of the IBM locations which use the system heavily. Our system may be accessed through dial-up terminals from all over the world.

Where do you find the phone numbers?

When a new account number is first established for you by APL Administration, they send a memo to your manager verifying that the account has been set up (...after all, he's the one who has to pay for it). Included in this memo is a list of phone numbers that you are authorized to use for dialing in to the system. Those phone numbers are different for each IBM location; that is, if you are in San Jose, you will use a different phone number for dialing in to Kingston APL than a user in Raleigh would use for dialing in to the same system. In general, we try to provide each of the major locations with local phone numbers for accessing our system. Those phone numbers are IBM Confidential (which is why they aren't provided here).

You are typically authorized to use only the phone numbers which have been set up for your own location. To get a list of the ones that *you* are authorized to use, "`)LOAD 1 PHONES`". Due to changes in local requirements, phone numbers do tend to change periodically. To keep current with those changes, we recommend that you `)LOAD 1 PHONES` and print out the list every month or two. In that way, you'll have alternate phone numbers on hand for whenever you may need them.

Keeping the hackers at bay

The *only* telephone access that we provide into our system is via the IBM tie-line network (the "dial 8" network). With increased awareness and concern that was raised a few years ago about the activity of "hackers" who could possibly dial in to our system from anywhere, we discontinued the last of the outside telephone numbers.

Arrangements have been made with the telephone companies to limit the circumvention of these restrictions. For example, the IBM internal telephone system at your location may have provision for transferring phone calls, but you will probably find that you cannot transfer a data call from an outside phone into our system.

If you are ever in the position of planning activities such as an off-site meeting which is to include a terminal demonstration of your applications, be aware of this restriction of phone lines. Special arrangements would have to be made with the IBM Security department at your location to have an off-site IBM tie-line phone installed for such a meeting, or to set up special switching arrangements. Certainly, if special requirements like that are ever needed, please ***get us involved***. ■

Signing On

When signing onto APLSV (or any other system), you should take precaution that your sign on number and password are not being exposed to view by others.

Signing on with a dial-up terminal

The first thing that you'll need to have to sign on is a telephone number that will connect your terminal into our system, as we discussed back on page 19. Armed with that number, you will now be able to make contact with our system. (We will not go into the details of how to use your particular terminal and modem or acoustic coupler here; that information is outside of the scope of this manual.

From any dial-up terminal, enter just a right-parenthesis [")"] and press **CARRIAGE-RETURN** to hide the next input, like this:

```
)
**********
```

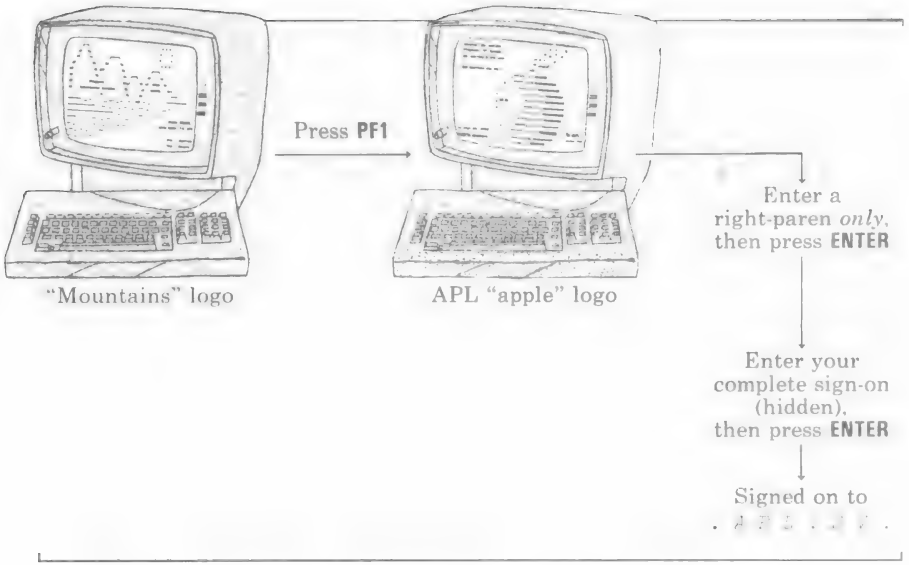
(Refer also to page 34).

Then sign on normally, entering your sign-on in the form of right parenthesis, account number, colon, and your private password, like this: "`)123456:ABCDEF`".

Signing on with a 3270 display terminal

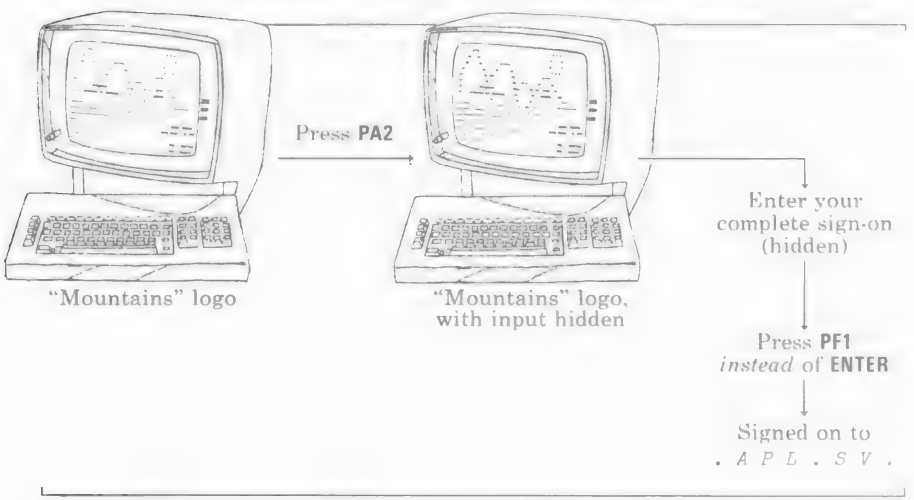
On Kingston APLSV, you can sign on from one of two places, either the "mountains" screen or the APL "apple" screen. No matter which way you choose to sign on, your sign on information can be inhibited ("blotted" out).

To sign on from the APL "apple" screen, enter just a right parenthesis [")"] on a line by itself, and press **ENTER**. Whatever is typed on the next line will be hidden.



The right-paren rule also applies during your session; see page 34.

To sign on from the "mountains" screen, enter **PA2** to inhibit your sign on. Type your sign on information at the bottom of the screen and depress **PF1**. Signing on this way will bypass the APL "apple" screen and "load-balance" you to one the APLSV systems... by "load-balance", we mean that there are monitors which continually measure the speed of operation of all of the APL systems, so that when you press **PF1**, you will be automatically routed to the currently fastest system.



Understanding Sign-on Error Messages

Contrary to some folks' fears, you are *not* faced with an infinite number of error messages that you can get at sign-on time; there are just seven (plus *no* message). In possibly increasing degrees of severity, they are:

- (no message at all)
- *RESEND*
- *NO APL PORTS AVAILABLE*
- *INCORRECT SIGN-ON*
- *NUMBER NOT IN SYSTEM*
- *NUMBER IN USE*
- *PASSWORD EXPIRED*
- *NUMBER LOCKED OUT*

No message at all

The first character of your sign-on is always a right-parenthesis. [The complete format for your sign-on is shown on the next page.] If you are using a dial-up terminal, APL looks for that first character to determine what kind of terminal you are using, so that it can translate its messages appropriately, to make them readable on that kind of terminal. If for some reason it doesn't see that first character (possibly due to noise on the phone line, or possibly because you didn't type it), it can't even send you a message telling you what's wrong, because it doesn't yet know how to translate the message.

RESEND

As with the previous case, this message only pertains to users of dial-up terminals. You have certainly had times during conversations with friends on the phone when you had to ask them to repeat what they said, because some noise on the line obscured what they said the first time. APL occasionally has the same problems as you and me [...it's only human, after all]. When it needs to have you re-type the entire line, it just says "*RESEND*" to you... a bit terse, perhaps, but it simply indicates that APL was not able to understand what you typed in. This is usually traceable to line noise or a faulty connection somewhere along the line (perhaps at your terminal or phone connection). If the problem persists, check all of the cable connections between the terminal's phone connection and the terminal itself.

If you have the same problem on all of the phone numbers that you try, you most likely have some problem with your equipment; you will have to contact the appropriate service people at your location.

If the problem goes away when you use a different phone number, that could indicate a problem with one of our phone lines. Be sure that you report that problem to the APL Help Desk (T/L 695-1234), so that they can have the phone line checked.

NO APL PORTS AVAILABLE

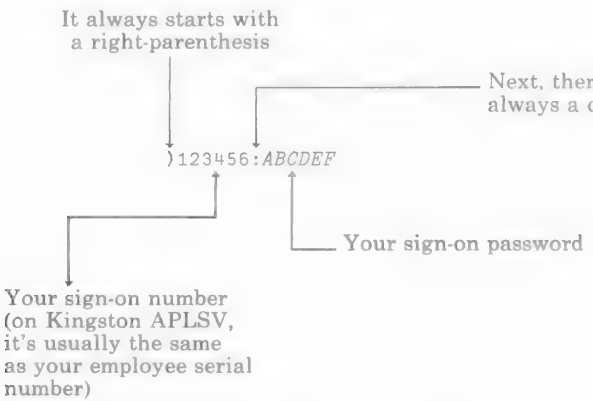
This message only occurs for users of 3270 and 3290 display terminals who connect in to APL by means of a network connection. Telephone connections into the system are referred to as "ports", and we only have a finite number of them available for network users. They have to be shared by anyone needing access, so they are made available on a first-come, first-served basis. "*NO APL PORTS AVAILABLE*" is sort of the system's equivalent of a busy signal.

It is also possible to see this message if you try to sign on after the system has shut down at night (at which time there are zero ports available).

INCORRECT SIGN-ON

This is a common one to get. It simply means that the *format* of your sign-on entry was wrong. It doesn't imply anything about whether your number is still active or whether your password is right. If you see this message, you haven't gotten that far yet.

The proper format for the sign-on entry is:



If it's not in this format, you won't get any further.

NUMBER NOT IN SYSTEM

This one sometimes causes confusion. When you sign on, you have to supply *both* a valid sign-on number (account number) *and* a password which is valid for that account number. If *either one* of those two things are wrong, you will get this message. Therefore, the message may mean that the sign-on number that you entered really isn't on the system, or (more frequently), it simply means that the password that you supplied isn't currently the right one for that number.

"*So why do they do this?*", you probably want to know. Why not make it simple, and just say *WRONG PASSWORD* or something like that? Well, that isn't done because doing that would give out too much information to someone who is trying to break in. (Yes,

we realize that *you* aren't trying to break in, *you're* just trying to get your job done. But occasionally, some people *are* trying to break in.)

If the number and password messages were separated, someone could simply keep trying different numbers until he got that mythical message of *WRONG PASSWORD*; then he would know that he had gotten the number right. After that, he would just have to keep trying passwords until he guessed the one for that account. That's why the *WRONG PASSWORD* message *doesn't exist*. You have to get *both* right.

Of course, it is possible that your account number really isn't on the system anymore. This would only ever happen if you hadn't used the account at all for several months. If that does happen, don't worry; all of your workspaces and files have been put on tape for safe-keeping. We can get all of them back up to two years later; no work will be lost. Just call the Kingston APL Administrator on T/L 695-5238. (Refer to the chart on page 30.)

NUMBER IN USE

Your APL account number is already signed on at another terminal. You *should* be the only one who uses your account number. If other members of your group borrow your account on a regular basis, perhaps they should get their own sign on number. When you *do* get on, "*)LOAD 1 FORMS*" and type "*APPLICATION*" to print out a blank form for getting an additional sign-on number for them.

If you *haven't* authorized others to use your account, is it possible that you yourself may have left the account signed on at another terminal? Be careful with this; as well as possibly getting a security violation from your site Security people, you are exposing your APL account to mis-use by others.

If no one else uses your account, and if you haven't left another terminal signed on somewhere else, please call the APL Hotline (T/L 695-1234) to see what's happening with your account. If someone is using the account without authorization from you,

1. Let's see if we can find out who is doing this (the Hotline can help here).
2. Let's get them off of the system (again, the Hotline can help).
3. Be sure to change your password as soon as you sign on to prevent this from happening again! (See pages 28-33.)

But how do you know if anyone uses your account when you're *not* around? ...What if you hadn't happened to try to sign on? That's why the "Last-Used date" is displayed when you sign on. (See page 27.)

PASSWORD EXPIRED

This one's pretty self-explanatory. You are required to change your sign-on password *at least* every two months. If you don't, the system will automatically prevent you from signing on.

This can be handled with one phone call to the APL Hotline, TTL 695-1234. They will remove the restriction for today only, so that you can sign on with your old password and change it to something else. If you don't know what your old password was, all that Administration can do is to *mail* a new password to you; passwords can never be given out over the phone. (See pages 28-33.) But assuming that you still *do* know your password, one phone call will get you going again.

NUMBER LOCKED OUT

Access to your account has been denied. If you get this message, the account *is* still on the system, but you are not allowed to use it. This can happen for any of several reasons:

1. If you let your sign-on password lapse and then didn't contact anyone for an additional month after the password expired, you will get this message. This indicates that your account is getting set for deletion—but it hasn't been deleted yet, so just a phone call to APL Administration will rescue it. (Refer to the chart on page 30.)

2. You or your manager may have sent in a Change Form, requesting that the account be deleted. If so, this is the first step.

3. APL Administration may have explicitly locked this account due to unresolved problems, such as a billing dispute.

4. If you don't respond to the APL Bi-Annual Re-Validation Audit, your account will be locked out. That's really our only means of ensuring compliance. If the account is locked due to the Audit, it will take more than just a phone call to get it unlocked; perhaps that's obvious. You will have to send in a completed Audit form (which Administration will be happy to send to you, via mail or VNET).

If the account is locked out, the effect to you as the intended user of account is the same as the `PASSWORD EXPIRED` case; you can't sign on. However, there is one additional restriction which arises with this escalation of the withdrawal of service. On an APLSV system like this one, users can freely use each other's workspaces (as long as they know the account number, workspace name, and workspace lock). If your password has expired, your cronies can still use your workspaces; that's usually a transient condition. But once the account has been locked out, it is frozen; no one can use any of your workspaces. An attempt to `)LOAD` a workspace from an account which has been locked out will result in a reply of `IMPROPER LIBRARY REFERENCE`. If you have workspaces which other users in your group routinely load from your account, be sure to keep your access to the system up to date. ■

One-Minute Sign-On Time-Out

Any dial-up customer who does not successfully sign on to the system within one minute of the initial phone connection will be dropped automatically from that phone line. This prevents unlimited attempts to sign on under a single dial-up.

Likewise, if you haven't completed the sign-on process on a 3270 terminal within one minute, the APL "apple" logo will also time out. ■

Logging of Unsuccessful Sign-On Attempts

Unsuccessful sign-on attempts are logged by the system, to enable us to trace attempted mis-use of the system. The log records that are created by these attempts are reviewed each day by APL Support. ■

"Last-Used Date" and "Password Expiration Date"

The date of the last use of your account is displayed at sign-on time, as an aid toward better security control of the use of your account. (How else would you know if someone had been using your account last week while you were out frolicking on the beach in Altoona?)

Also displayed at sign-on time is the date that your sign-on password will expire. Please remember that your password must be changed at least once every 63 days to prevent our security monitor from automatically locking the account out of the system on the 64th day. (This is discussed in detail on the next few pages.)

A typical APL session sign-on looks like this:

```
   OPR:  IMPORTANT ANNOUNCEMENT:  ALL USERS )LOAD 1 NEWS
   074) 14.48.22 10/29/84 KJDOE - KINGSTON, SYSTEM H
→→ LAST SIGNED ON 10/26/84, PASSWORD EXPIRES 11/29/84
   IBM BUSINESS USE ONLY

      . A P L . S V . I C .

   SAVED  16.30.11 10/26/84
```

■

Controlling Your Sign-On Password

Your sign-on password should never be disclosed to another person, and ideally, never written down.

All new accounts are supplied with a randomly-generated password. We recommend that you change it once a month. You *must* change your password within 63 days. If it has not been changed at the end of 63 days, you will lose access to your account on the 64th day.

Your APL sign-on password may be changed by using the)*PASSWORD* command. Used without an argument, it returns the date by which the current password must be changed:

```
      )PASSWORD
EXPIRES 04/10/84
```

To change your password, you must supply both the old password and the new password that you wish to start using:

```
      )PASSWORD oldpassword:newpassword
EXPIRES 06/12/84
```

The date that is returned following that operation is the expiration date of the new password.

If the "old" password that you enter doesn't match the one that's currently in use on your account, you will get a response of "*OLD PASSWORD INCORRECT*". You could also get a message of "*NEW PASSWORD UNACCEPTABLE*", usually due to the proposed new password being too short. In order to be in compliance with the security rules, a new password must be at least six characters long. It may be made up of any combination of A→Z, Ā→Z̄, 0→9, Δ, and Δ̲.

Passwords may be *up to* eight characters long... if a longer one is mnemonically meaningful to you, it's usable, but only the first eight characters will actually get used by the system.

"What happens if I don't change my password?"

If you *do* let your password lapse, don't worry; assuming that you call within a reasonable time after the password expires, it can still be resolved quickly. A phone call to the APL Hotline is all that's needed... they're on T/L 695-1234. They will want to know only your sign-on number, never your password. They can then assign a *grace* period for signing on with the old password, so that you can get on and change it. That grace period extends *only* through the current day; by the next morning it will have expired again. Therefore, if you are given a grace period, be sure to sign on and change your password right away.

If you don't call Administration within another 30 days after your password lapses, the account will be *locked* (you can't sign on, and no one else can use the workspaces). If you still don't contact Administration within 30 days after that, they will have to assume that you've gone away, and will archive the account to tape, where the workspaces and TSIO datasets will be held for two years. If your account has been deleted in this manner,

reinstatement to the system will require filling out a new application form.

Why 63 days?

Corporate requires everyone to change their sign-on passwords at least once every "two months". After discussions with Corporate Security, they agreed to let us interpret two months as 63 days. Since 63 days is an even multiple of seven, that means that your password will always expire on the same day of the week that you originally assigned it (if you should happen to let it go that long). Therefore, if your own routine was to change it on the first Monday of alternate months, you wouldn't find out that it had already expired on Sunday.

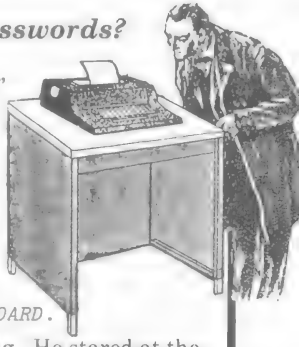
Realize, though, that these time periods are the *maximum* permissible time periods; we always recommend that your sign-on password be changed at least once a month, even though the only enforced limit is two months. If you are storing IBM Confidential Restricted data in your account, you should certainly change it more frequently than other users might change theirs.

●

On page 34 we describe a method of blotting out passwords, to keep others from seeing them. In that discussion, we recommend *against* using that method for hiding *new* passwords as they are being initially assigned, such as with this `)PASSWORD` command. If you have been using the "blot" command with this `)PASSWORD` command, you should refer to that discussion.

●

...An alternative to sign-on passwords?



"A machine's only a machine—isn't it?"

"This one isn't," Auberson said. "This one's human."

...Auberson thumbed a console to life.

"*HARLIE*," he typed, but before he could identify himself, the machine spat back, "*YES, BOSS?*" ...Auberson was startled.

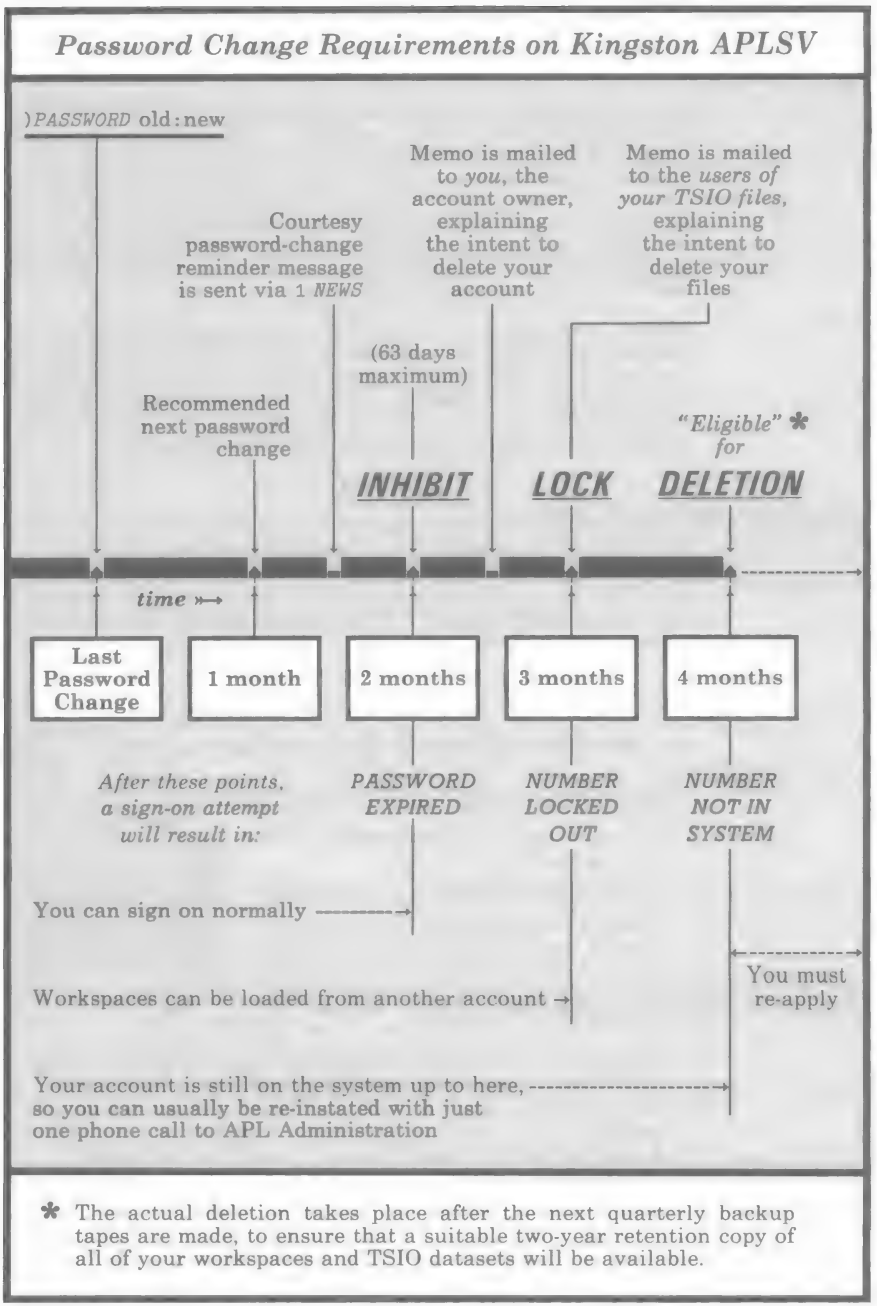
```
      HOW DID YOU KNOW IT WAS ME?
I RECOGNIZED YOUR TOUCH ON THE KEYBOARD.
```

Auberson jerked his hands back as if stung. He stared at the typer. It was a standard IBM input/output unit. Could HARLIE really sense the difference between one typist and another on its electronic keyboard? Apparently he could. It must be the minute differences in each person's typing.

...The silvery sphere of the typing element clattered across the page...."

—from *"When HARLIE Was One"*

A novel by David Gerrold, © 1972
Used by permission of Doubleday, Inc.



* The actual deletion takes place after the next quarterly backup tapes are made, to ensure that a suitable two-year retention copy of all of your workspaces and TSIO datasets will be available.

Proper Use of Passwords

All APL users should be aware that a password on their sign-on only protects the sign-on from unauthorized use and only protects workspaces associated with the sign-on from unauthorized modification.. The sign-on password does not protect against unauthorized access to workspaces associated with the sign-on. Protection of sensitive data stored in an APL workspace is possible only by associating a password with the workspace.

Your sign-on *must* be protected by a password (in fact, there is no way to remove it and run with no password). Any sensitive workspaces should also be be protected with passwords, and those passwords then take on the classification of the data that they are protecting (...if you are storing IBM Confidential Restricted data, your password is also IBM Confidential Restricted). We further recommend that the password that you use for signing on to APL be different from the password associated with your workspace.

We caution against using passwords such as initials, names of relatives or significant personal dates. Such personal information is more readily available than one might expect, and is specifically prohibited by Corporate Security Document 104A.

That document requires that passwords be "randomly selected, and neither obvious, nor trivial, nor predictable." Ideally, the password should be something that you can easily remember (so that you won't have to keep referring to a slip of paper... which perhaps someone else could get to). But it shouldn't be anything that someone else who knows you would guess. Using a randomly-selected, purposely-misspelled word is okay, but do *not* use terms that are identifiable with you (such as the make of your car or your dog's name). Believe it or not, those can often be guessed.

The use of the name of the month or your initials or nickname are common and easily guessed by anyone who wants to compromise the system. More esoteric, but still easily determined, are your spouse's birthday, your anniversary, your child's or pet's name, or even the name of an old acquaintance. We recommend against any of these approaches.

Good passwords can also be constructed from memorable phrases. This is an excellent way to get rid of that tune that bothers you night and noon. For example, "*GGTLASWD*" for "Green Grow the Lilacs All Sparkling With Dew."[4] ...Impossible to break (unless you whistle while you work).

Even better is the inclusion of one or more numeric digits with any of these schemes. But —as with characters— the numbers shouldn't have any particular significance that anyone else could guess. Any numbers that you include shouldn't represent the month and shouldn't simply be sequentially-incremented from last month's password.

---

[4] Shown for comparison only. Your taste in music may differ, and will probably be higher (except in California).

If you don't choose to be so original, workspace `10 SECURITY` can be used to generate random character strings (shown on the next page). Remember, however, to make a protected record of your password. If you forget it, the APL Administrator will have to assign a new password and have it mailed to your manager, leaving you without APL service for a few days. Be aware also that the APL Administrator can assign a new password to your account, but *not* to a workspace.

●

"Why should I have to lock my account? There's nothing in it!"

Any user on the system can load workspaces from another user. If someone signs on to your account, don't think of the exposure simply in terms of your own material... he can access *other* people's material. Unauthorized access, possibly even by an outside (non-IBM) user, could jeopardize the security of major applications.

"So what? I don't care!"

Then let's get a little bit more practical about this, and see if we can make it relate. Even aside from the security aspects involved if someone else gets hold of your password, any billing that they accrue will be sent to you. You wouldn't lend out your *credit card*, would you?[5] The same consideration, of course, is involved in lending your account to one of your co-workers: we don't recommend it. If your department needs more accounts, "`)LOAD 1 FORMS`" and type "`APPLICATION`" to print application forms. If someone else uses your account, they could use the system without being accountable for its use (...*you* would be accountable).

●

The Bottom Line

The protection of any system ultimately comes down to a sign-on password. No matter what else in this manual you pursue, no matter what other steps you take, your applications can only ever be as secure as the protection that you provide for your sign-on password.

If you are in charge of some "super-secure" application, but then let others see or guess your sign-on password, the system will of course assume that they are *you* if they should sign on with your account number.

Furthermore, even protecting your sign-on password is for naught if you then walk away and leave your terminal signed on and unattended. Again, passers-by could do anything with your account that you can.

Exercise care when you choose a sign-on password, protect it well, and don't ever leave an active terminal unattended. ...It's really the bottom line for everything else that's discussed in this manual.

---

5 If you *would*, please let us know... our car payment is due again.

Generating Random Passwords

We feel that it's best to choose a password that's meaningful to you, so that it can be easily remembered without writing it down (...a randomly-*selected* password). However, if you are intent on generating truly random passwords, workspace "10 *SECURITY*" has a function that will do it for you:

```
      ∇PASSWORD[□]∇
    ∇ Z←PASSWORD;R;N;ALF;□IO;□RL
[1]   ⍝CREATES RANDOM PASSWORDS (FOR APL WORKSPACES OR SIGN-ONS)
[2]    □IO←1
[3]   ⍝LIMITED ALPHABET RELIEVES CONFUSION BETWEEN '0' AND 'O', ETC.
[4]    ALF←'ABCDEFGHJKMNPRTUVWXYZ2346789'
[5]    □RL←+/□TS
[6]    □RL←?+/□AI
[7]    ALF←ALF[R?R←⍴ALF]
[8]    Z←ALF[6?R]
[9]   ⍝ IF YOU WISH TO HAVE RANDOM-LENGTH PASSWORDS, USE THIS:
[10]  ⍝    N← 6 7 8[?3]
[11]  ⍝    Z←ALF[N?R]
    ∇
```

Let's run the function a few times to try it out:

```
      PASSWORD
WYTKD4
      PASSWORD
KD9ZNG
      PASSWORD
JXTZ3R
      6 6⍴PASSWORD,PASSWORD,PASSWORD,PASSWORD,PASSWORD,PASSWORD
MGT4DR
HN8AEK
AGZ3RE
PKM2WZ
FECX4G
GB76UC
```

●

Sign-on passwords must be protected with at least the same measure of protection that is required for the data that they are protecting, with "IBM Confidential" being the minimum classification (since the system itself must also be protected). ■

"Display Inhibit" for Hiding Sensitive Inputs

Entry of a right-parenthesis only, at any time, will cause the next input to be hidden from view. Its uses include:

- Hiding your password at sign-on time
- Hiding a workspace password during)*LOAD* or)*COPY* operations
- Hiding *any* sensitive data

...or perhaps you just don't want that chap standing beside you to see which workspace you are loading.

On a 3270 Display Terminal, entry of a right-paren-only will put the terminal into "print inhibit" mode, so that the following line does not display as you type. For example:

```
      )                          ←—entry of a right-paren...
                                 ←—...hides the next line.
SAVED  16.20.15 12/08/84         ←—response from hidden line
```

See below for a discussion of Display Inhibit in full-screen mode.

Beware– This is NOT designed for entering NEW passwords!

We should point out that we do *not* recommend using this command for hiding a *new* password when you're entering it with the)*PASSWORD* command, because the chance for mis-typing it is too great. If you enter other than what you think you're entering, you will not be able to sign on the next time, and we will have to *mail* you a new password (...we can't ever give out passwords over the phone). For entering a new sign-on password (or for assigning a new password to a workspace), you're better off to just close yourself up in your office or terminal room, where no one else can see your screen or page, and enter your new password carefully.

Also remember to discard printed output in Confidential bins, and if you are using a 3270, sign off after entering a new sign-on password to clear the session logs (so that someone can't page back and look at the password if you step out of the office).

Dial-Up Terminal Users Only

On all hard-copy dial-up terminals, a "blot"-pattern of over-struck characters is printed to obscure the next input:

```
      )
      )LOAD ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓
SAVED  16.20.15 12/08/84
```

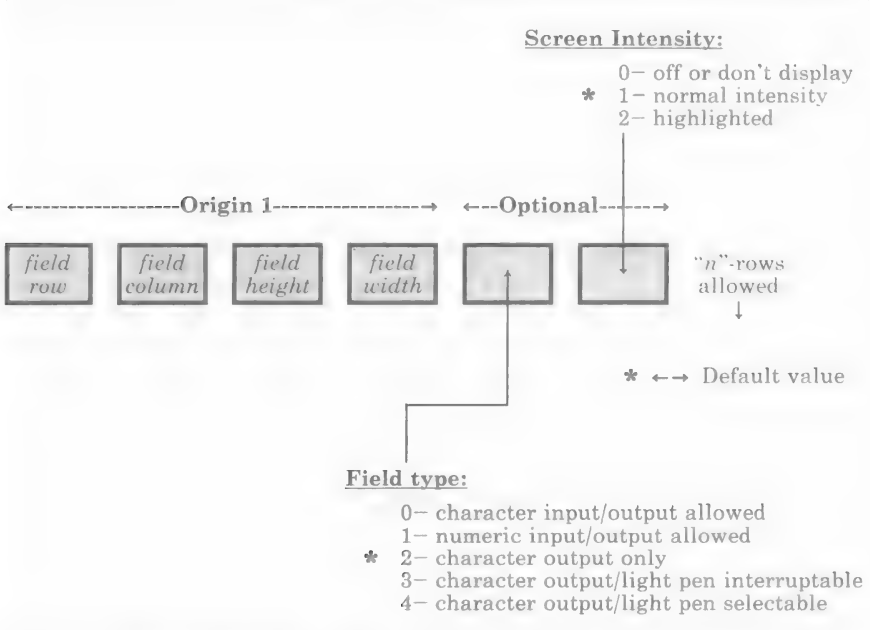
Please be aware of a security exposure that will always exist: if you are one of the *vanishingly few* people who have a typewriter terminal (such as perhaps a mag-card terminal) with a carbon ribbon, everything that you type is readable from the ribbon. Use of the blot will *not* change that; it's a hardware limitation that APL cannot change. Therefore, if you are typing something which is truly of a sensitive nature, you would be well advised to open the terminal cover, and put the ribbon in the "stencil" position before entering it, or if it is more than just a single entry, treat the ribbon just the same as you would treat any other IBM

Confidential material. Please note that this concern is related only to carbon ribbons, not to fabric ribbons or to the Tech-III ribbon.

Display Inhibit in Full-Screen Mode on a 3270

The "format" statement that's used with AP124 (the full-screen auxiliary processor) to format the various fields on the screen can be set up to include a non-display field, so that data which is entered from the keyboard gets passed to your program but will *not* display on the screen as it is being entered. This duplicates the facility which is used at sign-on time on a 3270, to hide your sign-on password.

The data variable may be "*n*" rows by 4, 5, or 6 columns. If *DAT* is a vector, it is treated as a 1-row matrix.



Complete details were published in the Fall 1980 issue of The APL Jot•Dot Times [the "Special Reference Issue"].

Here is an example of a function which prompts the user for input using full-screen mode to accept entries in a non-display field:

```
    ∇ Z←INT BLOT MSG;R;A;CTLS;DATS;H;W;ROW;COL;L;M;V;⎕IO
[1]  ⍝DISPLAYS (VECTOR OR MATRIX) MSG IN RT ARG; TAKES IN HIDDEN INPUT
[2]  ⍝...LEFT ARG:   INTENSITY OF PROMPTS (0, 1, OR 2) -- OPTIONAL
[3]  ⍝               IF NOT SUPPLIED, IT DEFAULTS TO:  2 1
[4]  ⍝               MAY BE ONE OR TWO ELEMENTS (FOR TWO FIELDS)
[5]  ⍝...RIGHT ARG:  TEXT FOR PROMPTS; MAY BE A VECTOR OR A MATRIX
[6]   ⎕IO←1
[7]   Z←¯1
[8]   MSG←(¯2↑ 1 1 ,⍴MSG)⍴MSG   ←—Turn input messages into a matrix
[9]  ⍝ ESTABLISH NEW SCREEN FORMAT
[10]  '→NOSHARE'⍎'A←124 ⎕SVO 2 4 ⍴''CTLSDATS'''   ←—Offer shares
[11]  A←1 ⎕SVC 'CTLS'   ←—Request tight interlocking of shared-variables
[12]  H←1↑⍴MSG          ←—Height of messages
[13]  W←¯1↑⍴MSG         ←—Width of messages
[14]  ⍎(0=⎕NC 'INT')/'INT←2 1'   ←—Default left argument for monadic call
[15]  →(~(⍴,INT)∈ 1 2)/0         ←—Validity-check left argument
[16]  ⍎(1=⍴,INT)/'INT←2⍴INT'     ←—Scalar extension
[17]  ROW←⌈0.5×24-H              ←—Calculate centering of
[18]  COL←1⌈⌈0.5×80-W                the message
[19]  L←81-COL
[20]  V←((ROW+1),COL,(H-1),W,2,1↑1↓INT),(ROW+H),COL,1,L, 0 0
[21]  DATS←M← 3 6 ⍴,(ROW,COL,1,W,2,1↑INT),V   ←—Create formatting matrix
[22]  CTLS←1                                  ←—Format the screen
[23]  '→0'⍎'→(0≠1↑Z←CTLS)/0'   ←—If other than 0 return code, exit
[24] ⍝ SET CURSOR POSITION:  NUMBER OF SCREEN FIELD, FIELDNUM, COLUMN
[25]  DATS← 3 1 1
[26]  CTLS←12
[27]  →(0≠1↑Z←CTLS)/0
[28] ⍝========  SET FIELD 1  ========================================
[29]  DATS←MSG[1;]              ←—First field is first row of message matrix
[30]  CTLS← 4 1
[31]  →(0≠1↑Z←CTLS)/0
[32] ⍝========  SET FIELD 2  ========================================
[33]  DATS←, 1 0 ↓MSG           ←—Second field is all other rows (if any)
[34]  CTLS← 4 2
[35]  →(0≠1↑Z←CTLS)/0
[36] ⍝========  SET FIELD 3  ========================================
[37]  DATS←L⍴' '                ←—Third field is the user's input
[38]  CTLS← 4 3
[39]  →(0≠1↑Z←CTLS)/0
[40] ⍝
[41] ⍝ READ DATA ON SCREEN AND RETURN STATUS VECTOR
[42]  CTLS←3
[43]  →(0≠1↑Z←CTLS)/0           ←—If other than 0 return code, exit
[44]  A←DATS
[45] ⍝ GET DATA IN FIELDS IN FIELDNUM
[46]  CTLS← 5 3
[47]  →(0≠1↑Z←CTLS)/0
[48]  Z←,DATS
[49]  A←⎕SVR 2 4 ⍴'CTLSDATS'
[50]  Z←(-+/∧\⌽Z=' ')↓Z         ←—Remove extra blanks from user's input
[51]  →0
[52] NOSHARE:⎕←'FULL-SCREEN VARIABLES COULD NOT BE SHARED'
[53]  ⍞       ←—If ⎕SVO encountered INTERFACE QUOTA EXHAUSTED, halt
    ∇
```

Section 4: Protecting Your APL Workspaces

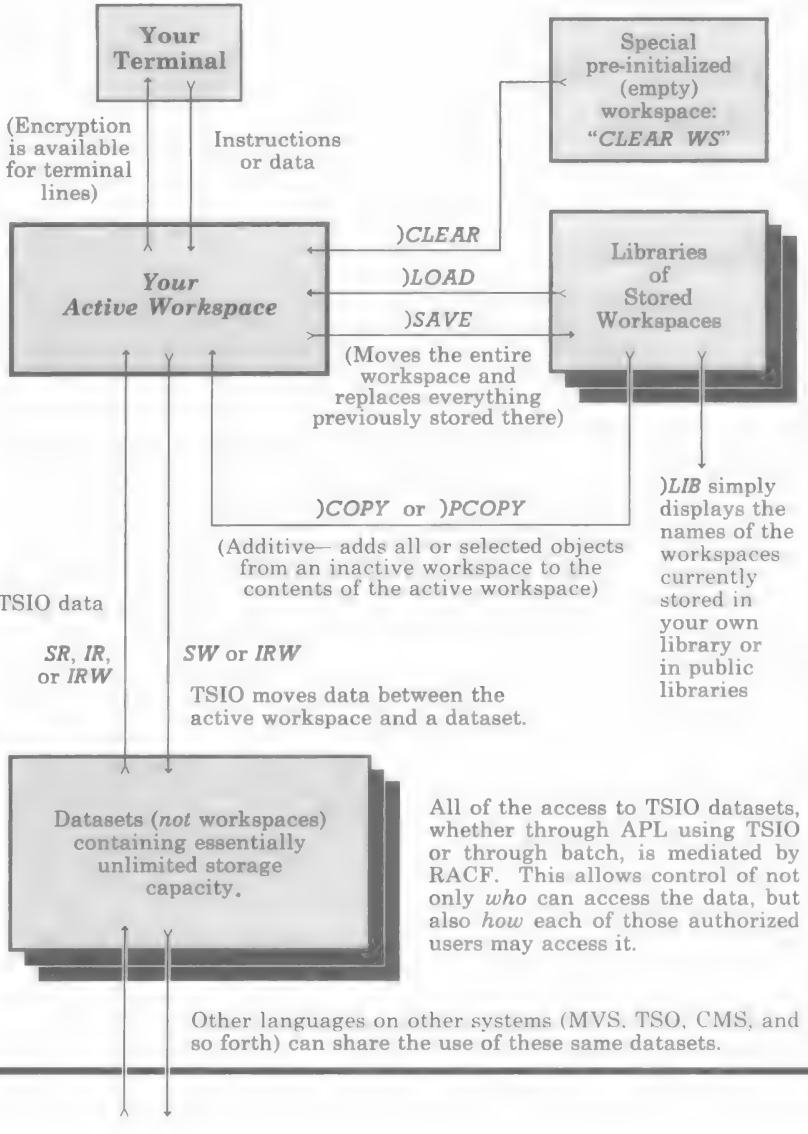
Workspaces and Libraries

The common organizational unit in an APL system is the *workspace*. When in use, a workspace is said to be *active*, and it occupies a block of working storage in the central computer. Part of each workspace is set aside to serve the internal workings of the system, and the remainder is used, as required, for storing items of information and for containing transient information generated in the course of a computation.

A terminal always has an *active workspace* associated with it during a work session, and all transactions with the system are mediated by it. In particular, the names of *variables* (data items) and *defined functions* (programs) used in calculations always refer to objects known by those names in the active workspace; information on the progress of program execution is maintained in the *state indicator* of the active workspace; and control information affecting the form of output is held within the active workspace.

Inactive workspaces are stored in *libraries*, where they are identified by arbitrary names. They occupy space in secondary storage facilities of the central computer and cannot be worked with directly. When required, copies of stored workspaces can be made active [by using the "`)LOAD`" command], or selected information may be copied from them into an active workspace [by using the "`)COPY`" command].

The Effects of Selected System Commands and TSIO



Libraries of Saved Workspaces

The set of workspaces that you have saved is called your *library*. Each workspace is identified by your account number and the name that you assign to it. However, in referring to workspaces in your own library, the account identification may be omitted: your own identification is then supplied automatically.

Rather than always re-inventing the wheel, it is often convenient to use functions or variables contributed by others. You can activate an entire workspace saved by someone else, or may copy selected items from it. To do so, both the library number and the name of the desired workspace must be supplied (along with the password, if there is one... more on that in just a moment). However, APL provides no way of learning either the account identification or the names of workspaces belonging to other users. Thus, you may make use of material from the libraries of others only if they supply that information.

In no case may you add, change, or delete material from someone else's library.

Libraries `1` through `999` are not assigned to individual users, but are designated as *Public* Libraries. Any user may obtain a list of workspaces in a Public Library, and may use public workspaces. However, only the owner of a workspace can save, drop, or modify that workspace.

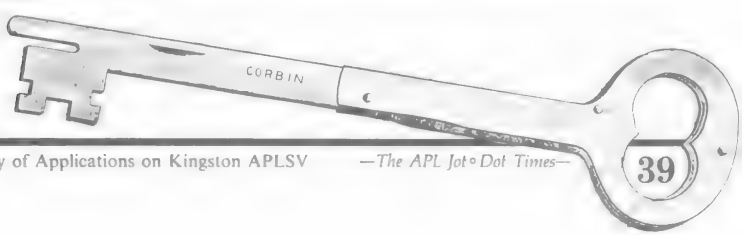
The contents of any Public Library may be displayed by entering `)LIB` followed by the library number [as in "`)LIB 1`"]. Once you get its name from the `)LIB`-command, a description of how to use any particular workspace in the Public Library may be displayed by `)LOAD`ing that workspace and then typing "`DESCRIBE`". By convention, any workspace in the Public Library should have some sort of descriptive text under the name `DESCRIBE`.

A list of the major offerings in the public library is available: `)LOAD 1 CATALOG`.

Locking Your Workspaces

Stored workspaces and the information they hold can be protected against unauthorized use by associating a *lock*, comprised of a colon and a *password* of the owner's choice, with the name of the workspace, when the workspace is stored. In order to activate a locked workspace using APL or copy any information it contains, a colon and the password must again be used, as a *key*, in conjunction with the workspace name.

If you have some information in a workspace that is classified as IBM Confidential or higher, or if you just don't want the average user accessing your workspace, you should put a lock on your workspace. In order for anyone to be able to load your workspace, they would need to know the workspace name and its lock.



A workspace is locked with the)*WSID* command or with the)*SAVE* command. To lock your workspace, type:

```
      )WSID workspacename:lock
WAS workspacename
```

or:

```
      )SAVE workspacename:lock
17.11.34 05/18/84
```

You must remember the lock you put on your workspaces. In this case, if you forget it, we cannot help you. The system allows the password to be from one to eight characters long, but we recommend that it be at least six characters long. This lock, as with your sign-on password, should be non-trivial.

To load a locked workspace, type:

```
      )LOAD workspacename:lock
SAVED 17.11.16 05/18/84
```

If you try to load a locked workspace without specifying the lock, the system will return "*WS LOCKED*".

Listings of workspace names, including those in public libraries, never display the keys, and do not overtly indicate the existence of a lock.

The user who has augmented a workspace name with a password has taken the first primitive step toward application security. This type of security should be considered to be more of an ensurer of privacy than a technique to control the sharing of a workspace with others. Disclosure of the password to another user allows that user full access and the ability to make his own copy of the workspace or to disclose the password to any other users.

The primary use of a locked workspace for security should therefore be as a repository of unlocked copies of functions which are locked in other workspaces. When used in this fashion, the workspace password (like the sign-on password) should never be disclosed to another user.

What If the System Creates a CONTINUE Workspace?

If your active session is interrupted due to line disconnections or terminal power disruptions, your active workspace will be saved under the name "*CONTINUE*" and will automatically be re-loaded for you when you next sign on. If there was a lock associated with the workspace that you had been using, that lock will also be used on the *CONTINUE* workspace, and in that case, the workspace will *not* be loaded the next time that you sign on. Therefore, if you had been using a workspace called "*PLAN*" with a lock of "*4TODAY*", you would normally activate it by entering "*)LOAD PLAN:4TODAY*". If your session became interrupted without you properly signing off, the next time that you signed on you would need to enter "*)LOAD CONTINUE:4TODAY*" to recover your work.

Extra Protection for the *CONTINUE* Workspace

APL never allows another user to inquire as to the workspace names in another user's account (that is, you cannot "*)LIB*" another user's private library). This is done for obvious reasons of privacy. Since most users often have a *CONTINUE* workspace, though, there has to be some extra protection to preventing a user from stealing material from another user's *CONTINUE* workspace The burden shouldn't be on the owner to lock it, since it's one workspace name that you don't usually have to guess.

This is prevented by allowing any workspace named "*CONTINUE*" to be loaded *only* by the owner's account; you cannot ever *)LOAD CONTINUE* from another user's account.

As a logical extension of this rule, a workspace named *CONTINUE* cannot appear in a Public Library.

Years ago, it was far too easy to sneak a peek at someone else's work, if you were just a bit devious. Let's assume that your manager was going over the salary plans on APL, and you really wanted to see what everyone earned. No problem; you'd just go out to the aisle, turn off the circuit breaker that controlled the outlet that his terminal was plugged into, and snicker as he got disconnected from APL. Then —knowing that his workspace was now in *CONTINUE*— you'd simply go back to your office and load it from his account. If he hadn't yet assigned a password to the workspace, you would get it, without even having to know the names of any of his regular workspaces. Obviously, that's not acceptable. APL hasn't permitted that sort of fraudulent bamboozlement since APLSV was introduced in the early 1970's. An attempt to "*)LOAD CONTINUE*" from any account other than your own will now result in *IMPROPER LIBRARY REFERENCE*.

The Workspace Guru

Restricted Libraries (Load-Only Workspaces)

At your request, APL Support can "*restrict*" a library for you. A "restricted library"[6] contains workspaces that can be loaded but not copied, either in whole or in part. It is also not possible to save these workspaces into another account [e.g., if the restricted library is a public library, when you load a workspace from it you cannot save it into your own account]. Likewise, an attempt to rename the workspace, via)*WSID*, will be rejected, as will)*CONTINUE*, since this implies a save. Finally, if the telephone connection is broken while a workspace from a restricted library is being used, or if the user is "bounced" off of the system, the workspace will never be saved in *CONTINUE*.

By restricting the workspace to load-only operation, a forced execution of any desired latent expression (□*LX*) is ensured. But please understand the limitations of the latent expression. It is discussed in detail on page 48.

Any attempt to bypass the security of this provision, such as entry of a)*SAVE*, rename via)*WSID*, or)*COPY*, will elicit an "*IMPROPER LIBRARY REFERENCE*" or "*COMMAND DISALLOWED*" message.

This restriction is not imposed upon the person who originally saved the workspace into that library; that is, he will be able to rename, resave, copy, without restriction.

It should also be emphasized that this restriction must be applied on a complete library basis... it cannot be applied to individual workspaces.

This facility provides an extra degree of "blanket coverage" protection for sensitive programs. It is a guarantee that even the users who are authorized to use the programs cannot save a copy into their own libraries. Why would you care about this? ...Well, if you discover a particularly devastating bug in your code someday, there's at least a modicum of peace in knowing that once you fix your single library copy, you have solved the problem; there *can't* be any other down-level copies floating around in various users private libraries, lurking around, waiting to destroy your database again tomorrow. While this does not in itself make an application *secure*, it helps.

An example of a restricted library is Library 1; while we encourage everyone to "`)LOAD 1 NEWS`" every day, you cannot)*COPY* items from `1 NEWS`. Library 1 has some sensitive material in it; this adds that little extra measure of protection to it.

If you would like additional information on this, or if you wish to restrict a particular library for which you are responsible, call the Kingston APL Hotline, T/L 695-1234, and ask for some programming assistance. ■

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[6] Also sometimes called a "*secured library*".

Confined Accounts (for Non-IBM Access)

Kingston APL has some accounts on the system which do *not* belong to IBM employees. These include consultants for projects within the company, vendors keeping inventories of the parts that they are supplying for IBM, universities doing studies for IBM, and even some accounts that are further removed from daily business, such as Boy Scout training programs. Obviously, we have to have mechanisms in place to be able to *guarantee* that these accounts cannot be accessing IBM material that wasn't set up for their use.

An APL account which has this control set up for it is referred to as a "*confined*" account. A confined account may only ever access the workspaces in *its own* private library, or the workspaces in *selected* public libraries.

Notice that this means that they can't even access each other's workspaces. On future services that we offer (such as APL2), this protection will be provided by RACF, which will finally give us the flexibility to allow separate groups of users to access each other's workspaces within their own group, but can prevent them from accessing other groups.

If the user of a confined account tries to `)LOAD` a workspace from another private user or from a public library which we have not designated for his use, he will receive a message of "`IMPROPER LIBRARY REFERENCE`". The same response will be given if the user issues a "`)LIB`" command to list the names of the workspaces in other than the designated public libraries. He is not only prevented from loading the workspace, he is also prevented from even being told of the existence of those workspaces.

In this way, the user is "confined" to his own particular area of operation, and the rest of the system just doesn't appear to exist to him.

IBM Open House or Family Day Arrangements

If your IBM site is planning to hold an open house or family day, and you have been assigned the task of setting up terminal demonstrations on Kingston APL, get us involved. We strongly recommend *against* simply signing on one of your standard accounts and letting the world use that. Attendants will always get called away at times, and all it takes is one mishap by one visitor to sour management on the idea of offering system access again. Those problems are easily preventable; contact APL programming support, and have us set up a new confined account for you. It removes the worry. ■

Section 5: Protecting Your APL Functions

Using System Variables

It is certainly not possible to describe *all* of the measures that can be taken to ensure that the person who executes your code is authorized to do so, because the requirements of what to check differ by application and by imagination. You have the full power of the APL language available to you for disguising data, checking user authorizations, and so forth. The APL system variables provide a wealth of information about the user, his environment, and his current session. Shown here are just some examples of common types of things to check; you may well have additional needs or ideas.

Localizing System Variables

If your application is depending upon the value of some of the user-settable system variables (such as ⎕*CT*, ⎕*IO*, and ⎕*PP*), it is important to localize these variables in your functions. If you don't localize them, it would be possible for a knowledgeable user to change their value and perhaps affect your calculations... possibly even to the extent of forcing your code to return invalid data.

Even if your code doesn't use the system variables directly, you should decide whether or not your code would be affected if they were changed. For example, you may not set the Index Origin (⎕*IO*) in your own code; you may simply depend upon it being set to the system default value of 1. But what happens if a user of your application changes it? Would that affect your code? ...Possibly it would. Be especially careful of some branch statements that may suddenly branch in the other direction if the index origin is changed. If this were to occur in your own code, you need to decide if it is possible that your personnel salary reporting package could show a user the salary history of everyone *except* himself! And would that be a problem if it did? A way to get around that is to localize it and set it to the value that you're expecting.

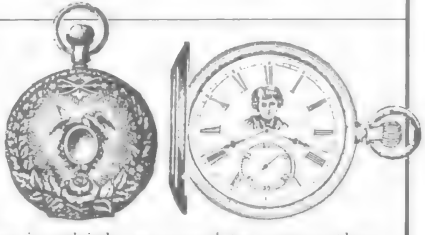
Another variable to be cautious of is the Comparison Tolerance (⎕*CT*). There are always some numbers that cannot be exactly represented on a digital machine (...in fact, there are more than those which *can* be precisely represented). To facilitate comparisons, APL lets you tell it that close is "close enough" when you're comparing two numbers. If they are the same out to

thirteen decimal places, you *may* want to consider them to be equal (even though, in fact, they may not be exactly equal). It's a very helpful facility in APL— when it's used properly. Comparison to thirteen decimal places is the default value, but you can specify your own tolerances. If some user specifies an overly-tolerant tolerance, you may find that suddenly everything is equal. This could be quite a sticky wicket for applications which compare a single value against a list of values, to return matching data. For example, in order to determine who you are and which mail is yours, the APL Mailbox has to encode your mailcode into a numeric value, and compare it against a list of all of the users. Suppose that a bizarre value of ⎕*CT* caused that comparison to match *every* entry. Delivering *everyone's* mail to you would be decidedly unpopular— with the senders, with the recipients, and with Security. Be sure that this value is localized and set to a meaningful value in sensitive code.

In applications in which you may format and execute numbers —not generally a good procedure, by the way— you should also consider localizing the Printing Precision variable (⎕*PP*).

●

By the way, contrary to what has occasionally been published in some other literature, APLSV does *not* provide a facility for reading the terminal-ID from within your application. We have now seen that published in a couple of other user's guides (always without the details of *how* to actually do it). Unfortunately, APLSV never has had that facility.

System Variables Which Are Commonly Used for Security Checks	
Name	**Description and Typical Uses**
⎕AI	**Accounting Information**: 1. User number (APL sign-on number) 2. Compute time this session (in milliseconds) 3. Connect time this session (in milliseconds) 4. Keying time this session (in milliseconds) Obviously, the most common use for this with respect to security is to check the user number against a list of authorized users. If you do this, the check should be in-line code in the function that you want to protect (not just in the latent expression). See page 48.
⎕LC	**Line Counter**: statement numbers of functions in execution or halted, with the most-recently-activated shown first. Used sometimes to determine whether or not it appears likely that a given function was called from within a standard calling sequence, or if it was just called individually. That procedure is not very reliable, since a user could simply call it from within a different function.
⎕LX	**Latent Expression**: executed automatically when the workspace is loaded. This provides a convenient facility for providing instructions to the users of an application, or to let the application "come up running" when the workspace is loaded, but it is often grossly mis-used as a security measure. Refer to the discussion entitled "Use and Mis-use of the Latent Expression," on the next page.
⎕RL	**Random Link**: used for the generation of pseudo-random numbers by the APL "roll" (*?n*) and "deal" (*n?n*) functions. See our discussion of this on page 109.
⎕TS	**Time Stamp**: 1. Year 2. Month 3. Day of the month 4. Hour (on a 24-hour clock) 5. Minute 6. Second 7. Millisecond  This can be useful for applications in which you need to ensure that the code cannot be run during certain times, such as off-shift or on weekends. It does *not* take into account differences in time zones; Kingston APL is a world-wide service, but the time stamp always shows Kingston local time. Also, if your intent is to allow operation only during IBM working hours, you will also be responsible to set up your own calendars for taking IBM holidays into account (which also differ by IBM location).
Further information is available regarding these system variables and others; see The APL Language Manual (GC26-3847).	

Use and Mis-use of the Latent Expression (⎕*LX*)

The APL statement represented by the Latent Expression (⎕*LX*) is automatically executed whenever the workspace is activated with a "*)LOAD*" command. Formally, ⎕*LX* is used as an argument to the execute function (⍎⎕*LX*), and any error message will be appropriate to the use of that function.

Here are some common forms of the latent expression:

To invoke an arbitrary function *F*:

```
⎕LX←'F'
```

To print a message upon activation of the workspace:

```
⎕LX←'''FOR NEW FEATURES IN THIS WS ENTER: NEW'''
```

To automatically restart a suspended function:

```
⎕LX←'→⎕LC'
```

The variable ⎕*LX* may also be localized within a function and respecified therein to furnish a *different* latent expression when the function is suspended. For example:

```
      ⎕LX←'START'

      ∇START;⎕LX
[1]   ⎕LX←'→0⍴⎕←''WE CONTINUE FROM WHERE WE LEFT OFF'''
[2]   'WE NOW BEGIN LESSON 2'
[3]   DRILL△FUNCTION
[4]   ∇

        )SAVE ABC
    19.24.32 11/29/84
```

On the first activation of workspace *ABC*, the function *START* would be automatically invoked; if it were later saved with *START* halted, subsequent activation of the workspace would automatically continue execution from the point of interruption.

Additional information is available in The APL Language Manual (GC26-3847).

It sounds easy so far, but BEWARE....

Some users have gotten themselves into trouble by assuming that this facility could be used for security checks as the workspace is loaded. We sometimes see this somewhat dangerous construction:

```
⎕LX←'CHECK'
```

...where *CHECK* looks like this:

```
    ∇ CHECK;A
[1]  ⍝...AN EXAMPLE OF A BAD APPROACH; DON'T DO THIS.
[2]  ⍝
[3]  ⍝LIST OF AUTHORIZED USERS:
[4]   →(~(1↑⎕AI)∈123456 234567 345678 456789)/NO
[5]  OKAY:⎕←'WELCOME TO THIS FACILITY; TYPE:  START'
[6]   →0
[7]  NO:⎕←'UNAUTHORIZED ACCESS'
[8]  ⍝EXPUNGE ALL OF THE FUNCTIONS AND VARIABLES:
[9]   A←⎕EX ⎕NL 2 3
    ∇
```

This approach is ***not*** *recommended!* It suffers from several serious problems:

Problem Number One:

The latent expression is *only* invoked if you)*LOAD* the workspace— *not* if you)*COPY* the workspace. No, that's not a bug; that's the way it's supposed to be. (It *is* possible, though, to have the library set up so that the workspaces can only be loaded and not copied. Refer to the discussion of Restricted Libraries on page 42.)

Problem Number Two:

Line 7 of the function expunges [dynamically erases] all of the functions and variables in the workspace. That's being done in an effort to simulate the action of)*CLEAR* [which can't be executed from within a function]. But realize that that's not quite the same. In particular, the workspace name is not changed to "*CLEAR WS*". That may sound trivial, but if you are the programmer who owns this workspace, you run the risk of forgetting to include your own account number, running the function, expunging everything, and re-saving the workspace— discarding all of your work in the process.

Problem Number Three:

Since the expunge function (⎕*EX*) can't currently expunge the function that it is invoked from, the *CHECK* function is left behind. If it is not locked, a user could display the function and get a list of the authorized users. While that may not be directly harmful, you should generally limit distribution of authorized account numbers to those people who have a need to know.

And, as if those problems weren't enough....

Problem Number Four:

[The *coup de grâce*]: No one ever said that the latent expression couldn't be interrupted, and in fact, it can be quite easily. If the user who loads this workspace is quick with the **ATTENTION** key (or **PA2** key) he can halt the operation of the *CHECK* function before it does its checking. Remember, the point of the *CHECK* function was supposed to be to keep

random users from seeing what's in the workspace. ***This won't do it.***

Picture the following scenario: You are lying in bed, late at night, and you hear someone prowling around through your house. So you go downstairs, see if he's supposed to be there, and if not, put him out and lock the door. Does that sound like a reasonable approach? ***NO!*** By that time, it's *too late!* If you really wanted to keep him out, you should have locked the door. And yet, this is exactly the same logic that you would be putting into your code by keeping a list of authorized users in the workspace, and then attempting to discard everything if the user isn't authorized to see it.

A much better approach would be to use a command dataset (described on pages 85-91) to selectively allow authorized users to open a dataset, and *if* they are authorized, they can access your sensitive data. If they aren't authorized, there shouldn't be anything in the workspace that you would be concerned about them seeing. ■

Erasing Functions and Variables Dyamically (⎕EX)

The expunge function, ⎕EX, provides the facility to dynamically eliminate an existing use of a name. By "existing use", we mean the current, most local copy. Thus, ⎕EX 'PQR' will erase the most local copy of the object PQR *unless* it is a label or a group; those may not be expunged. As one example of its use, certain name conflicts can be avoided by using this function.

The function returns an explicit result of 1 if the name is now unencumbered, and a result of 0 if it is not, or if the argument does not represent a well-formed name. A result of 1, therefore, signifies that the name is available for use, whereas a 0 signifies that it may not be used.

Expunging a shared variable will retract the sharing and erase the variable.

The expunge function applies to a matrix of names and then produces a logical vector result. ⎕EX will report a RANK ERROR if its argument is of higher rank than a matrix, or a DOMAIN ERROR if the argument is not a character array.

You may wish to compare the operation of ⎕EX with that of the ")ERASE" system command, (discussed in The APL Language Manual (GC26-3847)). One major difference (other than form) is that ⎕EX discards *the most local* reference to a name that is currently active (which *may* be a global object), and)ERASE discards *only global* references. ■

Locked Functions

At times, you may want to allow other users to access a workspace while keeping them from disseminating the particular procedures or algorithms that you used in solving the problem. ...Seeing the answer that you arrived at in solving a problem may be of interest to them; seeing *how* you arrived at that answer may be of more interest, and on occasion, may be something that you want to conceal (perhaps pending publication).

For those cases where you have discovered *The Meaning of Life*—but don't necessarily want everyone to see how you have determined it (even if they already happen to know the answer), APLSV provides a function locking facility. A locked function may be executed just like any other function, but it cannot be displayed or suspended, and thus cannot be examined by *any* user (including you).

The function locking facility differs from the workspace locking facility in two ways. Locking a workspace prohibits access by any unauthorized person, but does not prevent authorized users from examining the contents of the workspace. No authorization is inherently required for executing a locked function, but no individual, *including the originator*, can unlock the function to examine it or to change it. Once locked, it remains locked until erased. It is important to maintain an unlocked copy of the function in a separate workspace in order to be able to modify, update, or examine the process. Small amounts of critical data can be protected by including their localized specification within the locked function in which it is used.

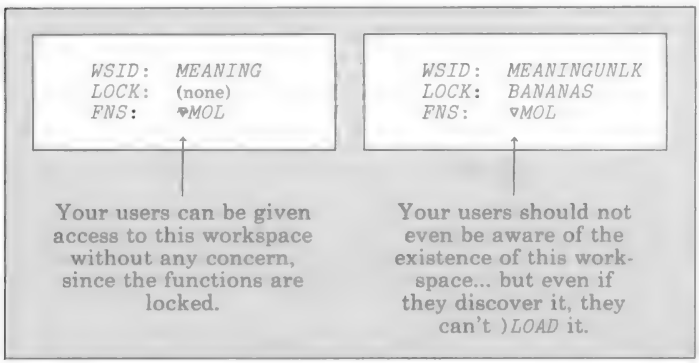
The procedure for locking a function is simple. If the symbol "⍫" (called *del-tilde* or *protection del*) is used instead of "∇" (called *del*) to open or close a function definition, the function becomes "locked".

A locked function cannot be revised or displayed in any way. An attempt to display the function will result in a "definition error":

```
      ∇MOL[⎕]∇        ←—displaying the function
    ∇ Z←MOL
[1]   ⍝THE MEANING OF LIFE
[2]   ⍝DO NOT RELEASE PRIOR TO ONTOLOGICAL SYMPOSIUM
[3]   Z←⍎⊖⍕|⌊-*+○⌈×÷!⌽⍉⌹⍴,⍟~0
    ∇

      ∇MOL⍫           ←—locking the function

      ∇MOL[⎕]∇        ←—trying to re-display it
DEFN ERROR
      ∇MOL
          ^

      MOL             ←—...but of course, it can still be used.
42
```

Any associated stop control or trace control is also nullified after the function is locked.

Once a function is locked, it cannot be unlocked again; locking is permanent. If you lock a function, be sure that you keep an unlocked copy of the function in another workspace. A common method of handling this is to keep the unlocked functions in a locked workspace, and to give other people access to the locked functions in a separate unlocked workspace:



Locking a function does these four things:

1. Prevent the display of the function (use of the built-in editors will return *DEFN ERROR*, and □*CR* will return a 0 by 0 matrix).
2. Prevent suspensions, as is done with primitive functions.
3. Ignore weak interrupts (attention) during its execution.
4. Convert error messages to *DOMAIN ERROR*, to further hide its internal workings. [Resource and environment errors, such as *WS FULL*, will continue to be reported.]

A locked function is treated essentially as a primitive, and its inner workings are concealed as much as possible. Execution of a locked function is terminated by any error occuring within it, or by a strong interrupt. If execution stops the function is never suspended but is immediately abandoned. The message displayed for a stop is *DOMAIN ERROR* if an error of any kind occured, *WS FULL* and the like if the stop resulted from a system limitation, or *INTERRUPT*.

Tying Your Shoes

You've probably all observed this human phenomenon: if you are interrupted while you are tying your shoes (an obviously primitive operation), there's just no way that you can resume from where you left off; you will undoubtedly have to untie them and start over again. Well, locked functions are just the same as you and me. [Tying your shoes was the *model* for locked functions.] If a locked function is interrupted during the course of its execution, execution is abandoned, and the function is *not* suspended. A locked function which has been interrupted will have to be restarted from the beginning; consider this if you are

planning to lock the functions which are used for a long-running process.

When a locked function is interrupted, the error line will be where the function was called. If a locked function was invoked by an unlocked function, that unlocked function will be suspended; if it was invoked by a keyboard entry the error message will be displayed with a copy of that statement.

Similarly, when a weak interrupt is encountered in a locked function, execution continues normally up to the first interruptable point: either the next statement in an unlocked function, or the completion of the keyboard entry that used this locked function. In the latter case, the weak interrupt has no net effect. When a weak interrupt is encountered, any printing which would otherwise have occurred at the terminal is discarded, but execution of the function continues, either until the execution sequence is complete or until a second interrupt is received.

Locked functions may be used to keep a function definition proprietary, or as part of a security scheme for protecting other proprietary information. They are also used to force the kind of behavior just described, which sometimes simplifies the use of applications.

Throw Away Your Old Building Blocks {*s*i*g*h*}

It *really* pains us to have to tell you this, but if you wish a locked function to be secure, it must not call any other functions or reference any global variables. *Heresy!* ...A few years ago, we devoted an entire issue of Jot to a discussion of recommended programming styles, and the cover story was, "How to Use Building Blocks." That was our "Access to Tools" issue, and we pointed out that a building-block approach "can result in some rather substantial benefits to you". Well, we *still* feel that way; we certainly don't want to have everyone abandon the clarity and ease of modular code and start putting everything in-line in huge, long functions. But for applications where you are concerned about security, be aware that users can erase sub-functions and replace them with their own functions.

Once they do that, all bets are off. If your main calling routine now calls *their* function (because its name matches the one that *you* used to use), they can, for instance, read the values of the variables that you have localized in your main calling routine. They may be able to slip past your security checks, and chances are, you'll never know that they did it. While single "stand-alone" functions are usually discouraged, this is one case where they are needed.

To re-emphasize the point: in any application in which you are concerned about the security aspects of what a user may access with your functions, the only way to ensure that he cannot tamper with the innards of your code is to package *everything* in one single stand-alone function, with *no* sub-functions and *no* global variables. Sorry. If you don't do that, you're kidding yourself.

But hold on, before you re-write everything; fortunately, there *is* an easier way. Read about our "*LOCALIZE*" functions on page 59.

They can do the job of localizing the sub-functions for you, and still let you maintain good building-block functions.

Prompting for Input from the User

If you need to prompt the user for some data while he is using your function, you should always use "⍞"-input instead of "⎕"-input. You should make certain that ⎕-input is ***never*** used within a locked function either directly or within any function that is called by that locked function. You should avoid ⎕-input because the user may otherwise be given the opportunity to gain too much information about the function —even though it's locked— by using the State Indicator commands ["`)SI`" and "`)SINL`"] when the keyboard is unlocked awaiting their input. Besides maintaining the security of the locked function, the use of ⍞-input also permits the use of more versatile and powerful input routines than does ⎕-input.

To reiterate that warning, *do not use ⎕-input* in a sensitive application! If you do, it's *not* secure. Refer to the discussions of Dyadic Execute on pages 66-71 for additional thoughts regarding techniques for prompting for user input *safely*.

Is This Really the Right Approach?

Locked functions are fine for cases where you want to keep the "browsers" out of your code (such as places where you may be using a new algorithm which you plan to publish). But don't consider locking to be absolute. If the workspace is transferred to another (*non*-APLSV) system, it is possible for a knowledgeable programmer to unlock the functions. And future implementations of APL (such as APL2) may treat the whole concept of locking functions differently than we do now. If you have particular needs or concerns regarding locked functions, we would welcome the chance to discuss it with you. Call us on the APL Hotline, T/L 695-1234, and ask for some programming assistance.

For places where you need to protect *data* (as opposed to APL code), ***a much better approach*** is to put the data into a "reserved" TSIO dataset, and use a "command dataset" to control access to that data. In this way, the data would not appear in the workspace at all unless the user had validated access authority. Refer to the discussions of "Dataset Privacy" on pages 85-91.

Bumper sticker of the week: | I ♥ FNS | (Seen on an "AUDI-T".)

Creating Functions Dynamically (⎕*FX*)

The definition of a function can be established, or "fixed," by applying the system function ⎕*FX* to its character representation. The function ⎕*FX* produces as an explicit result the character vector which represents the name of the function being fixed, while replacing any existing definition of a function with the same name. A halted function may be replaced using ⎕*FX*, but this will *not* replace the active copy on the stack.

The fix function has both a monadic and a dyadic form. We'll look at the monadic case first; the dyadic case is covered on page 57.

An expression of the form ⎕*FX M* will establish a function if *both* of the following conditions are met:

1. *M* is a valid representation of a function. It may be a matrix (with each row representing a function line). Any matrix which differs from the canonical representation only in the addition of non-significant spaces (other than rows consisting of spaces only) is a valid representation.

2. The name of the function to be established does not conflict with an existing use of the name for a variable, a label, or a group.

The first row of the matrix represents the *function header* and must be a format appropriate to a function header. The remaining rows, if any, constitute the *function body*, and may be composed of any sequence of valid APL characters.

If the expression fails to establish a function then no change occurs in the workspace and the expression returns a scalar index of the row in the matrix argument where the first fault was found. If multiple errors are present, only the first will be reported. (This value is origin dependent.) If the argument of ⎕*FX* is not a matrix, a *RANK ERROR* will be reported, and if it is not a character array, a *DOMAIN ERROR* will result.

For example,

```
      M← 2 8 ρ 'Z←ROOT NZ←N*.5  '

      M
Z←ROOT N
Z←N*.5

      ⎕FX M
ROOT                          ←—The name of the function is
                                 returned if ⎕FX completed
                                 successfully

      ∇ROOT[⎕]∇
    ∇ Z←ROOT N                ←—newly-created function
[1]   Z←N*0.5
    ∇

      ⎕FX 2 11ρ'Z←N ROOT Z Z←A*÷N      '
ROOT

      ∇ROOT[⎕]∇
    ∇ Z←N ROOT A              ←—function has been replaced
[1]   Z←A*÷N
    ∇

      ⎕FX 1 2 3
RANK ERROR                    ←—argument doesn't match
      ⎕FX 1 2 3                   conformability rules
      ^

      ⎕FX 2 10ρ'Z←A*÷N    Z←N ROOT Z'
1
↑
└———— The first row of the matrix isn't valid as a
      header line, so the function can't be created.
```

Creating Locked Functions Dynamically (Dyadic ⎕*FX*)

Now let's look at the *dyadic* form of ⎕*FX*.

A left argument may optionally be supplied to ⎕*FX* to control the optional locking of the newly-created function. If present, the argument must be a boolean value. If there is *no* left argument, the action will be the same as `0 ⎕FX M`. A `1` specifies that the resultant function is to be locked, a `0` specifies that it's to be unlocked.

```
  ⎕FX M     ...resulting function will be unlocked
0 ⎕FX M     ...resulting function will be unlocked
1 ⎕FX M     ...resulting function will be locked
```

The ability to create locked functions under program control is important for such applications as bringing proprietary APL functions in from a TSIO file. ■

Local Functions

⎕FX may be used to create *local functions* within other functions. The local names on the header line of a function don't only refer to variables; they may also represent functions. By placing the name of the function to be localized on the header line of the calling function, and using ⎕FX to create the new function, a function may be localized just as easily as any variable.

This is a good technique to use when you want to use a small piece of code many times within your main function (an obvious place for a sub-function), but you want to make sure that nobody can simply erase a global sub-function and replace it with a copy of their own, which does who-knows-what.

An example of a small function that often falls into that sort of category is an error-checking function for checking the return codes from TSIO. It would typically get used *many* times in a single main calling routine. We don't want to have to code all of the occurrences of that code in-line... that's a lot of work, and it creates maintenance problems. And we also don't want to leave the function out where it can be tampered with. So we do the same thing with the function that we do with any variable in the same situation: we localize it.

Let's look at an example of a function with a localized sub-function. When we give this function to other people to use, we plan to lock it, and we want to protect its sub-functions, too. Let's assume that our users are *not* authorized to see *all* of the data in the file... part of the purpose of this *SALES* function is to do the data-reduction side-step our protection. Here's how we can ensure that, by localizing our error-checking function called "*ERR*":

```
    ∇ Z←SALES;CTLSALES;A;M;⎕IO;ERR
[1]  ⍝RETURNS CURRENT DATA FROM THE SALES FILE
[2]   ⎕IO←1
[3]   A←370 ⎕SVO 'CTLSALES'
[4]   A←1 ⎕SVC 'CTLSALES'
[5]  ⍝LOCALIZE THE TSIO ERROR-CHECKING FUNCTION, TO PREVENT TAMPERING:
[6]   M←20↑'ERR R'
[7]   M←M,[1] 2 20⍴'→((1=⍴R)∧0∧.=R←,R)/0⋄⎕←''ERROR CODE: '',⍕R'
[8]   A←1 ⎕FX M   ←——This creates the local function
[9]   CTLSALES←''
[10]  ERR CTLSALES
[11] ⍝THE COMMAND DATASET ISSUES A SEQUENTIAL READ:
[12]  CTLSALES←'IC DSN=''123456.SALES.ACCESS(9)'''
[13]  ERR CTLSALES
[14]
```

The rest of the function goes here. [By the way, you would want that TSIO return-code checking function to be somewhat more sophisticated than this for a real application. Here, we are simply showing the *technique* of function localization.]

∇ Once we lock this main function, the sub-function is also protected.

■

Localizing Functions Dynamically

Workspace 10 *LOCALIZE* is designed to let a user make a copy of global functions and variables to appear as local functions and variables within a function of your choice. This provides an easy-to-invoke security feature, preventing users of your application from tampering with these sub-functions or variables.

The main function in the workspace is "*LOCALIZE*". Its form is *'FN' LOCALIZE LIST*, where *FN* is the name of the function that is to receive the local functions, and *LIST* is a list of objects to be localized (as a matrix of one name per line, or a vector of names separated by blanks, commas, or semicolons). The explicit result from "*LOCALIZE*" is a character matrix showing the lines which have been inserted into "*FN*" (for reference).

If the left argument (*FN*) is elided, then no function is rebuilt, but the explicit result still returns the data that can be inserted manually into a function.

Examples:

```
      )LOAD MYWORK
SAVED  ....

      )PCOPY 10 LOCALIZE LOCALIZEGP
SAVED  ....

    ∇ FOO;A
[1]   A←0
[2]  ⍝⍝⍝⍝
[3]   '' CHK TRY 'SR DSN←....
    ∇

      Z←'FOO' LOCALIZE 'CHK TRY OLE Q'
4 OBJECTS TO BE LOCALIZED...
NAME OF ERROR LABEL WITHIN YOUR FN TO BE BRANCHED TO
IF ERRORS OCCUR:  '∘'
FOO

    ∇ FOO;A;⍋;L;FX;CHK;TRY;OLE;Q
[1]   A←0
[2]  ⍝⍝⍝⍝
[3]   L←1
[4]   →(0=1↑0⍴L ⎕FX 8 14⍴'R←L FX T;V     T←(~V←T∊''∪''
[5]   →(0=1↑0⍴L FX 'A←B CHK C∪→(0=⍴,B)/L0∪A←B=1↑C∪L0:
[6]   →(0=1↑0⍴L FX 'A←B TRY C;D;E∪→(2=⎕NC ''PID'')/L0
[7]   OLE←32 18⍴'SUCCESS              IMPARSIBLE COMMAND
[8]   Q←0
[9]  ⍝⍝⍝⍝
[10]  '' CHK TRY 'SR DSN←....
    ∇
```

In this example, the function "*FOO*" has been modified such that the functions called "*CHK*" and "*TRY*" and the global variables called "*OLE*" and "*Q*" have been localized within "*FOO*". After the conversion, they still exist as global objects, and should be)*ERASE*d before the application is made available to other users.

Notice that the original function had four lamp symbols ("⍝⍝⍝⍝") on line two; this was to indicate to the "*LOCALIZE*" function just where the definitions of the new local objects should appear. After the conversion, these symbols appear both before and after the newly localized objects (lines two and nine).

Line three is a local variable that's used to indicate whether the local functions (if any) are to be created as locked functions (*⎕LX*←1) or as unlocked functions (*⎕LX*←0). The default is "*⎕LX*←1"... "*⎕LX*←0" tends to circumvent the security of the application, and should be used for initial debugging only (if indeed at all).

Line four is the definition of a local function called "*FX*"; it will appear any time that any other functions are localized, and is used for "boot-strapping" the other functions in. Since the other functions appear in a somewhat compressed form (to help to prevent *WS FULL* problems), "*FX*" is used to rebuild them when you run your function.

On lines five through eight are the definitions of the four objects that we asked to localize.

If you wish to edit the localized functions, it's not practical to edit them "in place" after they have been localized, so instead, their definitions may be removed from your function. You would then copy the original global functions and variables into your workspace, make whatever changes that you want, and re-localize the objects. To remove the local functions, and put the "*FOO*" function back to its original state:

```
      UNLOCALIZE 'FOO'
FOO

    ∇ FOO;A
[1]   A←0
[2]   ⍝⍝⍝⍝
[3]   '' CHK TRY 'SR DSN←....
    ∇
```

Limitations

During the execution of your function (the ubiquitous "*FOO*", in this example), there will be two copies of each object: the active local object, and the one-line definition that created it. Therefore, *considerable* extra space may be needed to use this procedure. If your application is already battling a *WS FULL* problem, this procedure will only aggrevate it [and you].

Realize also that it takes time to rebuild each of the local objects *every time* that you run your function. This procedure is therefore not without a price, but it may add an extra measure of security to your application that would be otherwise unavailable. It will certainly keep the sub-functions from prying eyes and tampering hands. ■

The "*SETBOMB*" Workspace

Workspace `10 SETBOMB` is designed to help you to set up checks within your existing functions to ensure that only authorized users can execute your code. This is an easy way to make your sensitive workspaces more secure. If an unauthorized user attempts to execute it, the functions will "bomb"-out, by expunging all of the other functions and variables in the workspace and preventing that user from continuing.

The salient function in this workspace is simply called "*SETBOMB*". It prompts you through the choices in easy-to-follow terms, and then automatically inserts the selected patches into your functions.

To use this facility:

```
)LOAD your workspace
)WSID SECUREWS:LOCKWORD
)COPY 10 SETBOMB SETBOMB
Execute "SETBOMB" once for each function to be bombed
)ERASE SETBOMB
Lock all functions
)SAVE
```

The "*SETBOMB*" function generates its "bombs" and inserts them into any specified functions, to check any or all of:

- the user's sign-on
- the latent expression
- the date
- any other logical condition that you specify.

When executed, it prompts you for:

- name of function to be bombed
- place where patch is to be inserted
- sign-ons of authorized users
- latent expression
- an expiry date
- any other condition that you want to have checked
- message to print when bomb is triggered
- should bomb expunge variables, functions, or both

For the most protection, you should have at least two bombs in each workspace:

1. a latent function checking (at least) the user's sign-on;
2. a master function checking (at least) the user's sign-on and the latent expression

This will protect you from all unauthorized use except someone using your own sign-on. However, you can take care of that by requiring the user to set some kind of variable password after loading the workspace, and setting a bomb to check it.

In using "*SETBOMB*", be sure to keep an unbombed, separately-named copy of your workspace. The bombs work all too well; you can easily lose the workspace if you trigger one accidentally. ■

Event Handling

While we always try to "do things right the first time" (...don't we??), there comes that inevitable time when we make a mistake. APL has planned ahead for this eventuality and lets you provide a layer of "blanket coverage" against errors.

> *"I claim not to have controlled events, but confess plainly that events have controlled me."*
>
> Abraham Lincoln, in a letter to A. G. Hodges, 4 April 1864

Sure, every APL programmer has been in this situation. Clearly, we need to let our functions *control* events. But before we learn how to handle those events, perhaps we should ask, "What *is* an event?" Fair enough. Webster defines an "event" as this:

> **event** \i-'vent\ *n* **1 :** the fundamental entity of observed physical reality represented by a point designated by three coordinates of place and one of time in the space-time continuum postulated by the theory of relativity **2 :** something that happens
>
> Webster's New Collegiate Dictionary, 1974

[Hmmm, let's use the latter definition here....] Okay, so an event is just something that happens. But surely we don't wish to invoke special handling for *everything* that happens: we want to be a bit selective. People tend not to observe the day *after* a birthday with quite the same zeal as the birthday itself. And in the APL environment, the same situation holds. *Any* action in APL can be considered to be an event; assignments, branches, calling functions are all events. ...They just may not be *noteworthy* events. So what makes an event noteworthy? ...The desire to observe it.

There are many places in programming where foreseeing some situation may not be possible, or even if it's possible, may not be practical to measure. Take, for instance, the most common example of checking for an error. Your programs, of course, should do "extensive error checking" if they are to be used in a production environment; anyone will tell you that.

But some things just aren't practical to check. You are always faced with a potentially *infinite* number of things that *could* happen during the execution of your programs - all things which are outside of normal operations. What happens if there's an unexpected `DOMAIN ERROR`? What happens if an error occurs that I haven't thought of? What happens if the user presses the **ATTENTION** (or **PA2**) key and interrupts the execution part way through? ...Welcome to Event Handling.

> *"Once the toothpaste is out of the tube, it's hard to get it back in!"*
>
> -H. R. Haldeman

APL provides the means for letting execution simply run its course, and *if* an abnormal situation occurs, for helping you to take corrective action.

You may have noticed by now that the previous page spoke of *events* as being a broad subject, but that we are now referring mostly to *errors*. Errors are indeed only one type of event that we might want to handle, but errors also happen to be the one type of event that the most people have had the greatest interest in handling. Because of this, most of the event handling in APL is aimed toward the handling of errors. So errors aren't the only things that are considered to be "events" (controlling the use of the **ATTENTION** key was one example of another kind of event) but errors *will* be the main subject of our following discussion.

Take the Worry Out of Running Code

If you are a programmer who writes any applications that you give to non-programmers to run, having one final catch-all procedure for trapping a totally-unforeseen bug before it halts the function and prints out a line of "Greek" (as non-APLers always seem to call it) can perhaps let you get a full night's sleep for a change. This will give you the facility, for instance, of creating an entry in a logging file that you may wish to construct if a bug occurs anywhere in your code while any of your users are running it. Okay, we know, *your* programs haven't had any bugs in them for years. ...Sure. But—even if we *did* believe you—*and we do*— ...yeah, sure... even things that work reliably for years will still fail eventually; everything does. [Escalators are *real* reliable, too, but I can still remember being trapped one day for four hours on an escalator when the power went off. ...You don't forget those things.]

•

In our discussions of event handling, we should take a look at the "execute" function. Execute isn't properly an event handling function, but its action is *so* similar to that of APLSV's event-handling function—"*dyadic* execute"—that *monadic* execute just seems like required reading for this context. So, here goes.

McGurk's Law:

*"Any improbable event which would create maximum confusion if it **did** occur, **will** occur."*

—H. S. Kindler,
from "Organizing the Technical Conference,"
Reinhold Publishing Company, 1960

Execute

Any character vector or scalar can be regarded as a representation of an APL statement (which may or may not be well-formed). The monadic function denoted by "⍎" takes as its argument a character vector or scalar and evaluates or *executes* the APL statement it represents. When applied to a character array that might be construed as a system command or the opening of function definition, an error will necessarily result when evaluation is attempted, because neither of these is a well-formed APL statement.

The execute function may appear anywhere in a statement, but it will successfully evaluate only valid (complete) expressions, and its result must be at least syntactically acceptable to its context. Thus, execute applied to a vector that is empty, contains only spaces, or starts with "→" (branch symbol) or ⍝ (comment symbol) produces no explicit result and therefore can be used only on the extreme left. For example:

```
      ⍎''
      Z←⍎''
VALUE ERROR
      Z←⍎''
        ∧
```

The domain of ⍎ is any character array of rank less than two,[7] and *RANK* and *DOMAIN* errors are reported in the usual way:

```
      C←'3 4'
      +/⍎C
7
      ⍎1 3⍴C
RANK ERROR
      ⍎1 3⍴C
      ∧
```

```
      ⍎3 4
DOMAIN ERROR
      ⍎3 4
      ∧
```

An error can also occur in the attempted execution of the APL expression represented by the argument of ⍎; such an indirect error is reported by the error type and followed by the character string and the caret marking the point of difficulty. For example:

```
      ⍎'5÷0'
DOMAIN ERROR
      5÷0
        ∧

      ⍎')WSID'
VALUE ERROR
      ) WSID
        ∧
```

---

[7] There's an additional restriction that only rarely surfaces: the character string must be composed only of valid APL characters. For example, even though the APL system uses various characters to control the operation of the terminal (such as idle characters, linefeed characters, and end-of-block characters), these characters are *not* APL characters, and therefore, they may not be used within a string that's to be operated upon with the execute function.

Using Execute to Assign a Value to a Supplied Name

An example of the use of Execute is a situation in which the user of the application is supplying a name for a variable, which then needs to have data assigned to it. The problem is to find a way to get data stored into a name which is really just represented as a character string. So that you don't lose sleep over this one, we'll just show you how it's done:

```
      DATA                    ←—Here's some existing data
3 5 7 11 13 17 19 23

      NAME
MYDATA                        ←—We want to move it into a
                                variable having this name
      MYDATA
VALUE ERROR                   ←—...which doesn't currently exist.
      MYDATA
      ^

      ⍴NAME
6

      ⍎NAME,'←DATA'           ←—This will do it

      MYDATA                  ←—Here's the new variable
3 5 7 11 13 17 19 23
```

Now, if you wish to *extend* it, and catenate more data to what's already there, you can do this:

```
      ⍎NAME,'←',NAME,',29 31 37 41'
```

or this:

```
      ⍎NAME,'←(⍎NAME),29 31 37 41'
```

Store under this name...

The data that previously existed under the same name...

...Followed by this new data

```
      MYDATA
3 5 7 11 13 17 19 23 29 31 37 41
```

Dyadic Execute

Discussions of execute have often alluded to the idea that ⍎⍞ can be used as "an alternative to ⍞-input offering more program control." Well, maybe, but any of you who have tried to actually *do* this have probably discovered that the problems start when the first user of your application types in an entry that's *not* a "well-formed APL expression":

```
      ⍎⍞
2+
SYNTAX ERROR
      2+
        ^
```

A function that is trying to prompt for a character string that represents a vector of floating-point numbers, and then execute it to get the string into numeric form, may well spend most of its time simply ensuring that the execution is going to work; every possibility of an erroneous input must first be checked. Perhaps the classic example of this is using "⌹" to invert a matrix: there are rules governing the acceptability of the matrix for inversion, but checking the matrix will probably take longer than the inversion. A nice approach would be to simply try it, and back off if it fails. Normal error behavior involves a halt to execution if it fails. But sometimes it's undesirable for an application to stop. Some means of getting control when an error occurs is needed. This may easily be done with dyadic execute.

Consider the case of ⍎*R*. If *R* can't be executed, an error message will be returned (such as *SYNTAX ERROR*, *LENGTH ERROR*, *WS FULL*, and so forth). Dyadic execute, *L*⍎*R*, will return exactly the same result as ⍎*R* if the execution *is* successful; the left argument will be ignored. But if *R* can't be executed, the expression will be treated just as if it was ⍎*L*. In particular, if the left and right arguments are *both* invalid, an error message will be reported that will look just as if the expression had been ⍎*L*:

```
      ⍎'3+'
SYNTAX ERROR
      3+
        ^

      '2+3' ⍎ '3+'
5

      '2+' ⍎ '3+'
SYNTAX ERROR
      2+
        ^
```

A particularly useful application of dyadic execute is "'→*OOPS*'⍎*FOO*", in which any problem in the character string *FOO* which would prevent it from being executed will cause a branch to label *OOPS*.

Dyadic Execute will switch arguments after any occurrence of an error in the right argument, regardless of the depth of the function calls that may have occurred in the right argument. For example, consider "'→*OOPS*'⍎'*FN*'", where *FN* is a function. If *FN* calls another function, *FN2*, which subsequently encounters a *DOMAIN ERROR*, the error will not be reported, but rather, ⍎ will immediately abandon execution of the right argument, and instead will execute the left argument (→*OOPS*).

Be aware of a frequent trap: a common approach is to enter an expression such as "*Z*←'→*OOPS*'⍎⎕" with the idea that an error would cause the function to branch. ...'taint so, McGee. If the input is executable, the expression can be viewed as "*Z*←⍎⎕". But if it's *not* executable, the expression becomes "*Z*←⍎'→*OOPS*'", or "*Z*←→*OOPS*" ...an immediate error. Therefore, although it's longer, a bit slower, and somewhat more cumbersome, what's *really* needed is "'→*OOPS*'⍎'*Z*←⍎⎕'".

Please realize that this primitive is *not* meant to be an all-encompassing coverage of generalized error side-tracking (...you'll have to wait for us to install APL2 in order to enjoy that benefit). [For instance, you may notice that it's not possible for APLSV to find out what the error was(!) *...c'est la vie.*] There are many situations where recovering from an error during execution will not be possible. But for situations in which you can anticipate a specific problem, and have a remedy for it, dyadic execute may be just the ticket.

If you do wish to pursue the applications of dyadic execute in the new APL2 systems, realize that this primitive has been slightly re-packaged for that environment. It is now called "⎕*EA*" ("execute alternate") under VSAPL and APL2; it's functionally and operationally the same as dyadic execute on APLSV.

Here's an example of a simple input-checking function which will prompt for numeric data, and will re-prompt if the input can't be executed:

```
    ∇ Z←NUM T
[1]  ⍝PROMPTS USER WITH MSG IN RIGHT ARG; EXECUTES INPUT
[2]  START:⍞←T
[3]   Z←⍞
[4]   →(Z∧.=' ')/EXIT
[5]   '→OOPS' ⍎ 'Z←,⍎Z'
[6]   →0
[7]  OOPS:⎕←'INVALID, PLEASE RETRY...'
[8]   →START
[9]  EXIT:Z←⍳0
    ∇


      R←NUM 'ENTER NUMERIC STRING:  '
ENTER NUMERIC STRING:  1 2 3 4.5.6
INVALID, PLEASE RETRY...
ENTER NUMERIC STRING:  ¯3.7
INVALID, PLEASE RETRY...
ENTER NUMERIC STRING:  1 2 3 4. 5.6

      ⍴R
5

      R
1 2 3 4 5.6

      R←NUM 'ENTER NUMERIC STRING:  '
ENTER NUMERIC STRING:     [user just presses ENTER]

      ⍴R
0
```

Note that if the function were "simplified" a bit, it could become difficult for a well-meaning user to exit from the function:

```
     ∇ Z←NUM2 T
[1]   ⍝PROMPTS USER WITH MSG IN RIGHT ARG; EXECUTES INPUT
[2]   START:⎕←T
[3]    '→OOPS' ⍎ 'Z←,⍎⎕'
[4]    →0
[5]   OOPS:⎕←'INVALID, PLEASE RETRY...'
[6]    →START
     ∇
```

[The user calls the function, but then decides to cancel or interrupt the function]

```
      R←NUM2 'ENTER NUMERIC STRING:  '
ENTER NUMERIC STRING:
INVALID, PLEASE RETRY...
ENTER NUMERIC STRING: ■
INVALID, PLEASE RETRY...
ENTER NUMERIC STRING:
```

[user just presses **ENTER**]

[user depresses the **INTERRUPT** key, *trying* to halt the execution, but to *no avail.*]

(...and on, *ad infinitum*...)

...*The Moral:* Although there may be some legitimate times where you want to "trap" a user's input without letting him interrupt the function, be sure that you use this sort of capability with discretion; don't make your functions unresponsive to the user.

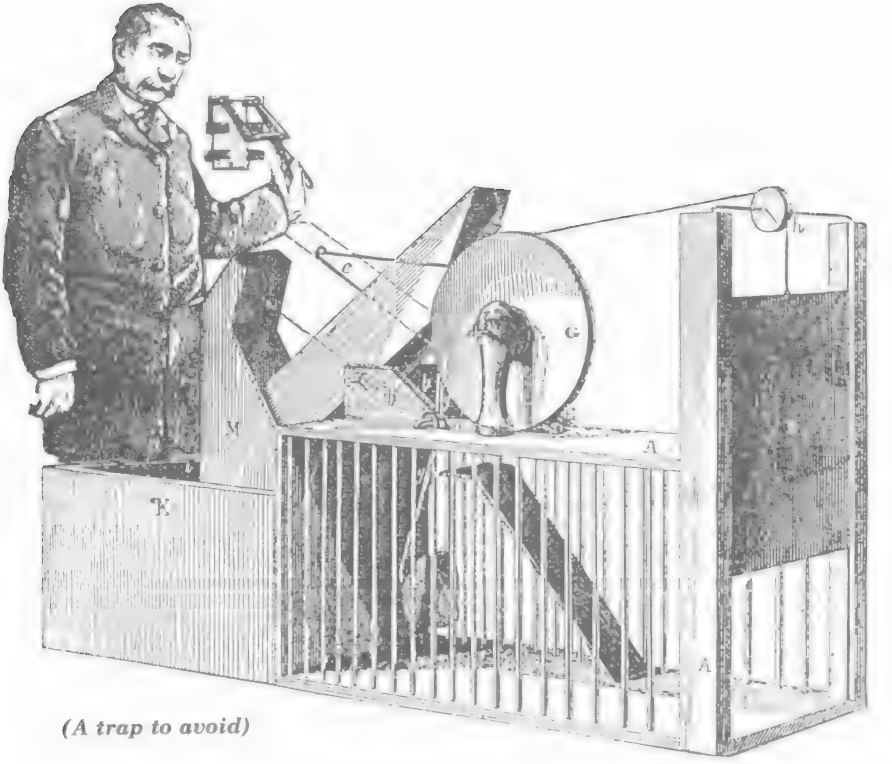
Be aware that, using dyadic execute, it is possible to write *uninterruptible* functions. You need to carefully consider the implications of a bug in your code, which may prevent a user from interrupting the execution of your code. If it can't be interrupted, and continues to loop at high speed, your users may run up a very large bill in a very short time. And guess who they'll come back to with their bill.... Be careful that you don't work yourself into a box. This one could cost you *elephant bucks.*

Also take care to avoid name conflicts in functions that use either monadic or dyadic execute. A user who is entering lots of repetitive data may wish to set up a variable in the workspace, and enter its name in response to the prompt for input. That's fine, but with this particular function he would suddenly discover "mysterious" operations occurring if the name that he chose was "*T*" or "*Z*" or "*START*" or "*OOPS*".

Additional Reading

If you are interested in reading more about the topic of Event Handling, you can order a copy of An Introduction to APL2 (SH20-9229). This manual has a chapter on Event Handling as it pertains to APL2, and will show the direction that you can consider taking with the design of your applications as soon as Kingston APL converts to APL2.

Alan Graham discussed "*Examples of Event Handling in APL2*" at the APL83 Conference in Washington, D.C. This discussion shows many of the features that are available under APL2, the system to which we will be converting over the course of the next couple of years. Many of the IBM site libraries have the proceedings from this conference, published as the Volume 13, Number 3 issue of the "APL Quote Quad". The proceedings are also available from ACM (The Association for Computing Machinery); order number 554830.



(A trap to avoid)

A Trap to Avoid

"After reading the section on dyadic execute, I was surprised that its usefulness was not demonstrated in the section on ambi-valent functions.[8] Your example of the *ROOT* function could very easily have employed dyadic execute:

```
    ∇ Z←N ROOT A
[1]   'Z←A*÷2' ⍎ 'Z←A*÷N'          {NOT recommended!}
    ∇
```

—A Jot•Dot Times Reader"

We received several such statements as a result of a previous Kingston APL newsletter. Say what you will about programming style, but we feel that this sample function brings up a potentially dangerous situation. You are anticipating a *VALUE ERROR* if *N* isn't assigned, forcing execution of the left argument. However, *any* error arising from the use of the left argument will have the same effect—even *WS FULL*.

As an example of this, "`3 ROOT 64 729 4096`" correctly finds the cube root of each of the values, yielding a result of "`4 9 16`". So far, so good. But realize that "`2 3 ROOT 64 729 4096`" *should* produce a *LENGTH ERROR*; instead it returns "`8 27 64`" —***the wrong answer*** and would allow a calling function to continue.

A more proper way of checking for the existence of the left argument is by the use of *⎕NC*. "*⎕NC 'N'*" (in this example) will return a `2` (meaning "variable") *only* if a left argument was supplied; it returns a `0` if the *ROOT* function was called monadically.

We recommend *against* the use of dyadic execute to circumvent normal, quick checks like this that have been traditional in the past, and we *especially* recommend against it if it's used as a return to "one-liners." ■

---

8 "Ambi-valent" functions are functions which may be used *either* monadically or dyadically. These functions support *both* valences; hence the name. This was discussed in the Fall 1980 issue of The APL Jot•Dot Times.

Section 6: Protecting Your TSIO Datasets

What Datasets Do You Own?

If you are like the rest of us, you probably own a couple of datasets that you no longer need, or didn't even know existed. How do you find out? (...thought you'd never ask).... Simply:

```
)LOAD 1 FILELIB
```

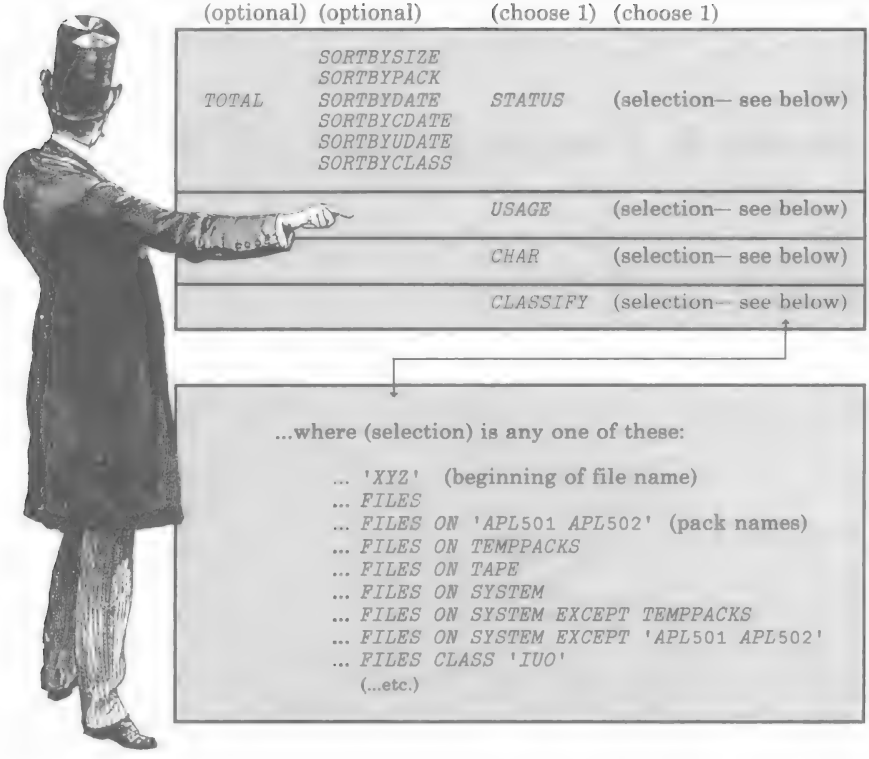
and type "*STATUS FILES*". Your dataset names will be displayed along with additional information such as the number of tracks allocated, the percentage utilized, when the file was created, and when it was last used. ("*CHAR FILES*" also provides some useful information about the characteristics of those files.)

You can think of "*FILELIB*" as being a bit like the "*)LIB*" command... it shows you your "library" of file names.

The functions in workspace "*1 FILELIB*" allow APL users to inquire about their OS datasets as used through TSIO. Information is available in four general areas:

- the names of datasets
- the status of datasets
- the characteristics of datasets
- the IBM security classifications of datasets

General Inquiry Form



Typical Inquiries

```
CLASSIFY FILES                    | CLASSIFY 'XX'
STATUS FILES                      | STATUS IC FILES
STATUS 'XX'                       | CHAR FILES
TOTAL FILES                       | TOTAL STATUS FILES
USAGE FILES                       | USAGE FILES ON 'APL501'
SORTBYSIZE STATUS FILES           | SORTBYPACK STATUS FILES
SORTBYDATE STATUS FILES           | SORTBYCDATE STATUS FILES
SORTBYUDATE STATUS FILES          | SORTBYCLASS STATUS FILES
TOTAL SORTBYUDATE STATUS 'XYZ'    |
CLASSIFY FILES ON 'APL501 APL502'
TOTAL STATUS FILES ON 'APL501 APL502'
TOTAL STATUS FILES ON TEMPPACKS
TOTAL STATUS FILES ON TAPE
TOTAL STATUS FILES CLASS 'IUO'
GROUPS
RENAME
DELETE
```

Here are some samples of usage of some of the major functions:

R←STATUS dsnames

Takes a dsname or names as the right argument and returns a matrix of status information about the datasets belonging to the user and included in the right argument. The display looks like this:

```
      STATUS FILES
[3]
VOLUME CREATED  LAST-USE TRACKS PCT EXT SEC RECFM DATASET-NAME
APL523 11/05/81 06/20/83     34  97   1     F    ¯123456 DOCUMENT
APL501 12/11/81 06/21/83      1 100   1     F     123456 REPORT
---ARCHIVED---- 11/22/78    325  59   1     F    ¯123456 SALES
```

Here's what the various fields represent:

VOLUME — the volume identification of the disk pack containing the dataset.

CREATED — the date (month/day/year) that the dataset was originally formed.

LAST USE — the date (month/day/year) that the dataset was last accessed (read or written) by anyone.

TRACKS — the number of tracks of disk space allocated to the dataset.

PCT — the percentage of allocated tracks actually being used in the dataset.

EXT — the number of contiguous areas (extents) on the disk used to contain the dataset.

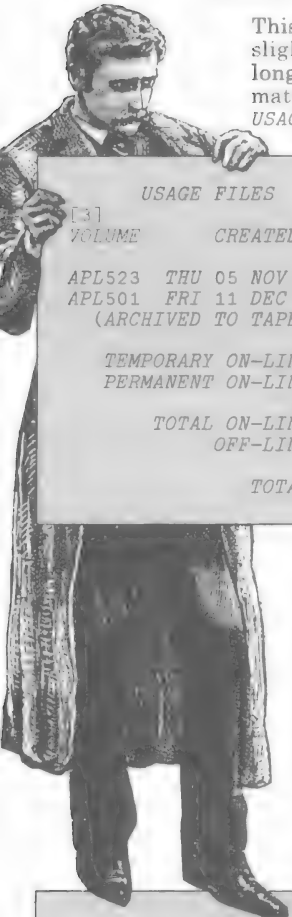
SEC — the number of blocks (physical records) requested as secondary allocation space when the dataset was created. For more information, see the description of the space parameter in The APLSV Version 3 User's Guide (SH20-9087).

RECFM — the record format of the dataset, indicating whether the data is fixed or blocked.

DATASET-NAME — the name of the dataset, with a negative number indicating that the dataset is "reserved" (that is, restricted to access by you only). See pages 85-91 for a complete discussion of this.

CLASS — the security classification of the dataset, (only shown when *SORTBYCLASS* is specified).

USAGE dsnames



This function is similar to *STATUS*. Since its display is slightly fancier than the output of *STATUS*, it takes a little longer to run. *USAGE* always automatically totals the information. The security classification is always shown when *USAGE* is run.

```
      USAGE FILES
[3]
VOLUME      CREATED        LAST-USED   TRACKS PCT EXT CLASS DATASET-NA

APL523  THU 05 NOV 81  MON 20 JUN 83     34  97   1  IC    123456 DOCU
APL501  FRI 11 DEC 81  TUE 21 JUN 83      1 100   1  UNCL  123456 REPO
  (ARCHIVED TO TAPE)   WED 22 NOV 78    325  59   1  IUO   123456 SALE
                                        ------
   TEMPORARY ON-LINE:     0 FILES          0 TRACKS
   PERMANENT ON-LINE:     2 FILES         35 TRACKS ON DISK
                        ---             ------
       TOTAL ON-LINE:     2 FILES         35 TRACKS ON DISK
            OFF-LINE:     1 FILE         325 TRACKS ARCHIVED
                        ---             ------
               TOTAL:     3 FILES        360 TRACKS TOTAL
```

R←CHAR dsnames

Takes a name or names as right argument and returns a matrix of expressions which are subsets of the expressions which might have been used to allocate the respective datasets.

```
      CHAR 'SALES'
RECFM=F,BLKSIZE=19069,LRECL=19069,SPACE=(13069,(325,0)),DSN=...
```

Note that "*STATUS*", "*CLASSIFY*", "*USAGE*", and "*CHAR*" can take "*FILES*" as their right argument. Some examples of their uses are:

```
CLASSIFY FILES          ←—classify all files
CHAR FILES              ←—characteristics of all of the files
STATUS 'ETC'            ←—status of all files starting with "ETC"
STATUS 'ETC '           ←—status of the single file named "ETC"
                          (not just those starting with "ETC"...
                          notice the blank after the name)
USAGE FILES             ←—status and totals combined
TOTAL STATUS FILES      ←—status and totals combined
TOTAL FILES             ←—just the total information
```

One of the more useful inquiries is simply "*TOTAL FILES*", which will show how many files you have, and how much space you are being billed for:

```
      TOTAL FILES

 ON-LINE:      1 FILE          1 TRACK ON TEMPORARY DISK
 ON-LINE:      1 FILE          1 TRACK ON PERMANENT DISK
              ---              -------
 ON-LINE:      2 FILES         2 TRACKS ON DISK
OFF-LINE:      2 FILES       650 TRACKS ARCHIVED ONTO TAPE
              ---              ------
   TOTAL:      4 FILES       652 TRACKS TOTAL
```

Notes on Temporary versus Permanent Datasets

Permanent TSIO datasets are created by using the "*ALLOCATE*" function in workspace "1 *AIDS*". Datasets created by *any* other means are temporary, and are deleted by the system one week after they are created. For more information regarding the use of "*ALLOCATE*", see page 79.

How and Why Datasets Are Archived

Due to the demands for APL disk space available for new TSIO file allocations, we have installed a data set archiving system. Files that have not been accessed for six months are eligible for archiving. Likewise, files that belong to accounts which have been deleted from the system ("orphan files") are also eligible for archiving. All of these data sets are dumped to tape. One copy is kept in our library for future restores, and the other is stored offsite as a backup copy. The archive tapes will be retained for four years. Once a file has been archived, the owner will no longer be billed for its space. (Note: file archiving by user request is not available.)

If you try to open a TSIO data set that has been archived, you may get a return code 18. The old description of TSIO return code 18 was "*VOLUME UNAVAILABLE*". The message has been changed to "*OFFLINE / ARCHIVED*". If you use the "*OLE*" matrix for TSIO error reporting, you can copy an updated version from workspace 30 *TSIO*.

Status information for your archived files (in addition to on-line data sets) will still be available in workspace 1 *FILELIB*.

Deleting an Archived file from the listing:

Any file, archived or on-line, may be deleted by using the "*DELETE*" function in 1 *FILELIB*... but there are some notes of caution that you should be aware of, so be sure to read the complete discussion on page 83.

The programmers amongst you may wish to use the "*ARCHDEL*" function to delete archived files. The "*ARCHDEL*" function takes

as a right argument a single file name in quotes or a matrix of file names (one per line) to be removed from your *FILELIB* listing. This change will not be reflected, however, until the next time that the *FILELIB* dataset is updated (usually early each morning).

Once a file is removed from archive *it is gone for good*, so please use care when deleting your files.

Getting Data Back from Archives

To get an archived file restored, call The APL Control Centre on T/L 695-6772. The files will be recalled from archive as quickly as possible, usually within the same day.

Miscellaneous Additional FILELIB Functions

RENAME	Renames a specified file
DELETE	Deletes a specified file
GROUPS	Displays a list of the first-level qualifiers and the number of files which begin with that qualifier

Files that have been archived are displayed with "*ARCHIVED*" under the volume heading in the status display. To selectively display them, type:

```
STATUS FILES ON TAPE
```

To display only your on-line data sets, type:

```
STATUS FILES ON SYSTEM
```

To exclude temporary files from the display, you could say:

```
STATUS FILES ON SYSTEM EXCEPT TEMPPACKS
```

You can selectively display your files on any pack, or exclude specific volumes from the list like this:

```
STATUS FILES ON 'APL501 APL502'
CHAR FILES ON SYSTEM EXCEPT 'APL501 APL502'
```

You can selectively display your files according to security class:

```
STATUS FILES CLASS 'UNCL'
```

To display those files which have *not yet been classified at all*, enter:

```
STATUS FILES CLASS ''
```

To obtain a list of first level qualifiers and the number of files that occur under each, type:

```
GROUPS
```

To display only your IC datasets, type:

```
STATUS IC FILES
```

●

For a discussion of the implications of *deleting* a dataset, please refer to page 83.

Further reading is available from The APLSV Version 3 User's Guide (SH20-9087). Refer to Chapter 3. ■

Classifying Your TSIO Datasets

Corporate Security Instruction #104A states that "Ownership [of data] conveys authority and responsibility for ... classifying the assets and reviewing control and classification decisions" [page 133]. Corporate further requires that "Owners must ... classify input, output, data, and software; review classification and controls for appropriateness and adequacy at least annually ..." [page 148], and further that "all data and software must be associated with its owner, classified appropriately and controlled accordingly." [page 149]. To be in compliance with all of that, *all* of your permanent TSIO datasets must be classified. But don't panic; classifying them is really quite simple. Here's how it's done.

Classifying Newly-Created Datasets

New datasets are created by using the "*ALLOCATE*" function in workspace "1 *AIDS*". That function now also prompts for the dataset's security classification, so newly-created datasets will be classified as they are created.

Here's a sample session, showing the creation of a new TSIO dataset, and specifying a security classification of Internal Use Only for it:

```
      )LOAD 1 AIDS
SAVED  10.22.11 08/24/84

      ALLOCATE

  TYPE  ?  FOR ASSISTANCE

====> DO YOU WISH THIS DATASET TO BE
      RESERVED OR NON-RESERVED?      R

====> ENTER DATASET NAME:    -123456 MYDATA

====> ENTER NUMBER OF TRACKS:  10

====> ENTER SECURITY CLASSIFICATION:   ?
  Security classification is required.  Enter UN for
  unclassified, IU for IBM Internal Use Only, IC for IBM
  Confidential, or IR for IBM Confidential Restricted.
  If you want to classify a file as IC or higher, the
  file must be reserved (negative account number).

====> ENTER SECURITY CLASSIFICATION:   IU

YOUR DATASET HAS BEEN CREATED WITH THESE CHARACTERISTICS:
-------------------------------
STATUS     PERMANENT
DSN        -123456 MYDATA
RECFM      F
BLKSIZE    6233
LRECL      6233
SPACE      (19069,(10,0))
VOLUME     APL531
UNIT       3350
CODE       A
SECURITY   IU
```

Additional information is available for all of the prompts

You may now wish to format the dataset with a particular block size which your application needs; that's easily done by using *INITIALIZE* in the same workspace:

```
      INITIALIZE
DATASET NAME: -123456 MYDATA
BLOCK SIZE: 19069

10 RECORDS INITIALIZED
```

You have seen how new files will get classified as they are created, but there will always be some files which were not classified at the time of creation on our system... perhaps they are files which were transmitted to us over the network, or created or installed by a batch job. These datasets will not carry any security classification until you manually enter one for them. In no cases do we ever supply a default classification; it's always up to you to say what the classification is.

On pages 73-78 we discussed workspace 1 *FILELIB*, which is used for seeing what TSIO datasets you have. The same workspace may be used for classifying those datasets. Several new functions have been added to make classification as simple as possible. The new functions include *CLASSIFY*, *SORTBYCLASS*, and *CLASS*.

CLASSIFY will allow you to classify your TSIO datasets. It takes as a right argument a matrix of filenames (*FILES*) or a character string. The character string can either be a single filename or a qualifier for a group of files. You may use the *GROUPS* function to find out what groups you have and classify those all at once using the first level qualifier as the argument to *CLASSIFY*.

```
CLASSIFY FILES   ←—(all files)
CLASSIFY 'ETC'   ←—(all files beginning with "ETC")
CLASSIFY 'ETC '  ←—(a single file named "ETC")
```

There are two different ways you can classify your files. You can classify them all at once, giving all files the same classification, or you may classify them individually. If you are using a 3270-type terminal, you will automatically be presented with a full-screen panel to do the classifying.

You may give your datasets one of four classifications:

0 = Unclassified
1 = For IBM Internal Use Only
2 = IBM Confidential
3 = IBM Confidential Restricted

Note: Registered IBM Confidential is *not supported* on Kingston APLSV. You cannot assign this classification to any dataset on the system.

The function *SORTBYCLASS* is used in conjunction with *STATUS* and *USAGE*, to give a list of filenames sorted by their classifications. Files not yet classified are listed first. Following this the files are listed from the highest classification (ICR) to the lowest (UNCL).

Some examples of using *SORTBYCLASS* are:

```
SORTBYCLASS STATUS FILES
SORTBYCLASS USAGE 'ETC'
SORTBYCLASS STATUS 'ETC '
```

An additional function, *CLASS* takes as its right argument any of the abbreviations for security class: *UNCL*, *IUO*, *IC*, and *ICR*. *CLASS* will return a listing of only those files with that specific classification. Some examples of its use are:

```
SORTBYCLASS STATUS FILES CLASS 'UNCL'
CLASSIFY 'ETC' CLASS 'IUO'
SORTBYCLASS USAGE FILES CLASS 'IC'
```

If you have any problems or questions regarding these functions, please feel free to call the APL User Support Group at any time for assistance. The APL Hotline number is T/L 695-1234.

You can also use these functions to review the security classifications already given to your files. You should periodically make sure that the original classification of the file is still accurate.

Corporate Security Instruction 104A requires that a self-assessment be conducted *at least* annually, and further, that you, the user, be able to demonstrate that you have done so. A means of meeting this requirement would be to keep a dated listing of your file names and their classifications in your desk so that you can produce it if you or your management are audited.

●

We have tried to make the dataset classification procedures simple, straightforward and fast. We have provided the tools, but it is your responsibility to do the actual classifications and to be in compliance with Corporate Security requirements.

As always, if you have any questions or comments regarding these facilities, feel free to call us at T/L 695-1234. ■

Deleting TSIO Datasets

If you wish to delete any file, active or archived, it's easy to do that. First of all, we should point out that the active files are costing you a penny per track per week to store them, while the archived files are free... there is no storage cost whatsoever for having your files held here in archives. Therefore, if you even suspect that you might *ever* want to get the files back, we recommend that you leave them in archives... just be sure to classify them; that only takes a minute or so to do. (For more information on dataset archiving, type "*ARCHIVEHOW*" in workspace "1 *FILELIB*".)

However, if you are very sure that you *never* will want the archived data again, you can easily delete it by using the *DELETE* function which we provide for this purpose: "*)LOAD 1 FILELIB*" and type "*DELETE*". You will be prompted for the file name. This will now delete *any* file (active or archived).

In particular, please realize that you do *not* need to have an archived file brought back on-line in order to delete it.

It all sounds simple, but BEWARE....

Be aware of a special requirement here: If you had been storing IBM Confidential Restricted data in the file which you are now planning to delete, Corporate Security Instruction 104A stipulates that the data "must be erased or overwritten when it is no longer required" [See "Disposal of Unencrypted Residual Information", on page 143]. There is a possible problem which this procedure will prevent. It is very unlikely but technically possible—to have a user allocate a new dataset and find that it has another user's data already in it.

Realize further that this problem has nothing to do with APL; the same requirements hold for any other language running under the MVS Operating System. The situation could occur if a user deletes a dataset and the next user allocates a dataset which happens to be put on the space on the disk which was just freed up, and creates a dataset which has exactly the same blocksize, the same record format, and the same logical record length. If that situation occurs, and if the new user reads the dataset before he writes any of his own data to it, it is technically possible to read the data which belonged to the old dataset which was supposedly deleted.

Realize that "deleting" a dataset doesn't actually remove any data from the disk pack... it simply sets a flag which says that that space is now available for re-use. To be absolutely sure that no one else can retrieve your data, the data should be overwritten *before* you attempt to delete it.

This can be done with code which you supply for yourself, or it may be handled by using the function called "*INITIALIZE*" in workspace 1 *AIDS*. This is the same function which is used to format a dataset which you have just created with the *ALLOCATE* function. The *INITIALIZE* function simpy writes the block number to each block, which overwrites (and destroys) the previous data.

```
      )LOAD 1 AIDS
SAVED   10.22.11 08/24/84


      INITIALIZE
DATASET NAME: 123456 MEANING.OF.LIFE
BLOCK SIZE: 19069

100 RECORDS INITIALIZED.


      DELETE
ENTER ACCOUNT NUMBER (NEGATIVE FOR RESERVED DATASETS)
AND DATASET NAME:

DELETE DSN=123456 MEANING.OF.LIFE
ON-LINE DATASET '123456 MEANING.OF.LIFE' DELETED
```

Reserved versus Non-Reserved Datasets

Each of your TSIO datasets has your APL account number associated with it. While it is possible to read and write your own datasets without specifying an account number, as in "*CTL←'SR DSN←DATA'*", a more complete form of the same command for a user with APL account number 123456 would be "*CTL←'SR DSN←123456 DATA'*".

While the system does allow you to leave off the account number, it's always a good practice to include your account number with the dataset name when you write any code, so that it can be executed by another user. In that way, multiple users could use your data. Since any other users are given access to your data, this is referred to as a *non-reserved* dataset. For example, a non-reserved dataset name is "123456 *MYDATA*". Any non-reserved dataset can be accessed freely by anyone on the system. ***Only non-confidential data should be stored in this type of dataset.***

A *reserved* dataset is a dataset that can be accessed *only* by its owner... it is said to be "reserved" for your own usage. A reserved dataset name looks like this: "¯123456 *MYDATA*". If you are signed on with any account number other than the account number that the reserved dataset is under, an attempt to access it will result in a return code of "2 – *RESTRICTED COMMAND*".

So far, we have established that a reserved dataset is distinguished from a standard (non-reserved) dataset by means of the account number: for a non-reserved dataset, it's a positive number that matches the account number; for a reserved dataset, it's the negative version of that same account number. If you don't specify an account number at all, it defaults to a non-reserved dataset (anyone can access it, if they know the name).

And yes, you can have one of each of those datasets with the "same name"... that is, you could have *both* "123456 *MYDATA*" *and* "¯123456 *MYDATA*". Since the account number is part of the dataset name, those are completely different dataset names, and will comfortably co-exist.

Well, a reserved dataset seems to be a nice security feature, but there's one major problem: if it keeps out *everyone* except the owner, that's somewhat overly restrictive. All of the processing for any sensitive project would have to take place on a single account number. So —of course— there's an extension to that.

Command Datasets

A *command* dataset is a special instance of a reserved dataset; that is, a command dataset is always reserved, but further, it's a special dataset which contains (you guessed it) commands and lists of user numbers that can use each of the commands. [See the function called "*IC*" in workspace 1 *AIDS* for building and maintaining command datasets.] You can put any TSIO command that you wish in your command dataset, and may specify exactly

who may use each of the commands. When they use them, they are executing them just as if they were under your account number; that is, they have your access to those commands, and so can access your reserved datasets just as if they were you... if you authorize them.

If you are user 123456, you'd get this response:

```
      CTL←'SR DSN=¯123456 MYDATA'
      CTL
0     ⟵(successful)
```

But if you are any other user, you'd get this:

```
      CTL←'SR DSN=¯123456 MYDATA'
      CTL
2 1   ⟵(restricted command)
```

No problem. If you *want* to let a certain user (or even *all* users) have a specific type of access to your dataset, you can put that same command into a command dataset, and authorize the appropriate users. Then, they would access it like this:

```
      CTL←'IC DSN=¯123456 GATE(7)'
      CTL
0     ⟵(successful)
```

In this command, the name of the command dataset is "¯123456 *GATE*", and the command that this user is authorized to access has been put into command slot 7 of that dataset. The command that's being used is *IC*... "Indirect Command".

So far so good. What more could you ask for? Well, just one more problem: the command that appears in the command dataset had to be a *complete* command, not just a portion of the command. Therefore, if you wanted to let certain people access any of your twenty datasets for indexed-read only, you had to have twenty commands. Hmmm, seems like there ought to be a better way... and so, of course, there is:

Symbolic Parameters in Indirect Commands

A *symbolic parameter* can be thought of as being, in many respects, analogous to an APL variable. What's often needed is a way to put *most* of the command in the dataset, and stipulate what parameters may be added, but then allow the user to supply values for those parameters.

A symbolic parameter is distinguished from other TSIO terms and values in that it begins with "∧" (the APL version of what JCL sees as an ampersand: "&"). This term would then be used both in the command within the command dataset and in the command that calls that one. For example, assume the command in the command dataset to be "*SR DSN=¯123456 ABC,DISP=∧D*". When this command is invoked, the command would look like this:

```
      CTL←'IC DSN=¯123456 GATE(7),∧D=SHR'
      CTL
0
```

Notice that the "*DISP=∧D*" in the command within the command dataset will be filled in with the value supplied by the user, "*∧D=SHR*", allowing TSIO to read the string as "*DISP=SHR*".

If you are a user who is entering the *IC* command, the name of the symbolic parameter that you enter must, of course, match the name that appears in the command dataset. That name can be from one to eight characters long, alpha-numeric (*A→Z* and *0→9*). The first character may not be numeric. The first three characters may *not* be *SYS*... that's a reserved prefix, which gives us some additional features.

Reserved Names for Symbolic Parameters

Several special names have been established which the system will replace with a value upon their use (a table of these terms follows shortly). For example, one such term is *∧SYSDATE*. This term returns the current date in the form "YYDDD" (Julian date). If you wish to be able to create a new dataset whose name contains the current date, this can be done by placing a command in a command dataset like this:

```
SW DSN=¯123456 D∧SYSDATE
```

If this were the 250th day of 1984, the system would then treat the command as though it were

```
SW DSN=¯123456 D84250
```

Notice that we put an alphabetic character ("*D*") in the command so that the dataset name won't start with a numeric. The symbolic name may be used to replace any *portion* of a term (but it *can't* be used to pass more than one term). For example, consider the following commands:

Example 1:

Command dataset contains this:	`IR DSN=¯123456 D∧SYSDATE`
User enters the command as this:	`IC DSN=¯123456 GATE(7)`
and TSIO sees command as this:	`IR DSN=¯123456 D80250`

Example 2:

Command dataset contains this:	`I∧X DSN=¯123456 MINE`
User enters the command as this:	`IC DSN=¯123456 GATE(8),∧X=RW`
and TSIO sees command as this:	`IRW DSN=¯123456 MINE`

Example 3:

Command dataset contains this:	`SR DSN←¯123456 WEEK∧WK`
User enters the command as this:	`IC DSN=¯123456 GATE(9),∧WK=19.B`
and TSIO sees command as this:	`SR DSN=¯123456 WEEK19.B`

Example 4:

Command dataset contains this:	`SR DISP←∧D,DSN←¯123456 ABC`
User enters the command as this:	`IC DSN=¯123456 GATE(12)`
and TSIO sees command as this:	`SR DISP=,DSN=¯123456 ABC`

...Trivia Department: Notice that a specification arrow ("←") can always be used in place of an equal-sign in any TSIO command... TSIO will make the substitution.

Notice also that the command dataset won't see any value from a symbolic name if that name isn't specified; that's okay, the system will supply the default value. In the example used here, TSIO would treat the command as though it had been entered as "*SR DISP=SHR,DSN=¯123456 ABC*".

If you would prefer to specify your own defaults, you can do that: just enter the command in the IC dataset like this: *BLKSIZE←^BLK,^BLK←19069*.

●

Reserved Names for Symbolic Parameters

Term	Purpose	Sample
^SYSACCT	Account number	123456
^SYSPACCT	Positive account number (same)	123456
^SYSNACCT	Negative account number	¯123456
^SYSPCODE	"Scramble" of positive account	*AAAB.JEA*
^SYSNCODE	"Scramble" of negative account	*PPFOBNMA*
^SYSTIME	Time of day (HHMMSS)	152148
^SYSHOUR	Hour (HH)	15
^SYSMIN	Minute (MM)	21
^SYSSEC	Second (SS)	48
^SYSDATE	Date (YYDDD)	84245
^SYSYEAR	Year (YY)	84
^SYSJDAY	Day of year [Julian day] (DDD)	245

Note: "*^SYS*" is a reserved prefix; no user-generated symbolic names may begin with "*^SYS*". Also, no specification is allowed to these names.

These names (and all symbolic parameters) may only be used by a command within a command dataset; they may not be invoked directly.

The "scramble" of the account number is an encoding that TSIO uses to name datasets. Although you see your dataset as "123456 *MYDATA*", TSIO sees it as "*TSIO.AAABOCEA.MYDATA*". [While you (as a standard "Level 10" user) can't specify this name directly through TSIO, knowledge of its existence may be helpful for dealing with datasets moving on and off the system.] All TSIO datasets start with "*TSIO.*", to identify them, and the next eight characters are an encoding (or "scramble") of the account number: 123456←→*AAABOCEA*, and ¯123456←→*PPPOBNMA*. The functions for performing this translation are as follows:

```
    ∇ Z←SCRAMBLE N
[1]   Z←⍕'ABCDEFGHIJKLMNOP'[⎕IO+(8⍴16)⊤N]
    ∇

      SCRAMBLE 123456 ¯123456
AAABOCEA
PPPOBNMA

      ⍴SCRAMBLE 123456 ¯123456
2 8


    ∇ Z←UNSCRAMBLE N;⎕IO
[1]   ⎕IO←0
[2]   Z←N
[3]   →(~∧/Z∈' ABCDEFGHIJKLMNOP')/0
[4]   →(8≠⍴Z)/0
[5]   Z←16⊥'ABCDEFGHIJKLMNOP'⍳Z
[6]   Z←Z-4294967296×Z>2147483647
    ∇

      UNSCRAMBLE 'AAABOCEA'
123456
```

Let's assume for a moment that you have done all of your homework as far as using IC datasets and setting up symbolic parameters, so that the access that you provide for other people to access your datasets seems pretty secure. Congratulations. But, just how secure is it? Could we be overlooking anything?

APLSV currently provides an environment in which the *names* of TSIO datasets cannot be acquired by another user, and if you lock the APL functions that are used to access those datasets, the users can't even see the name of the command dataset.

Let's consider that for a moment; that's a pretty important point. If any of the people who use your APL functions could discover the *name* of the command dataset that you are using to access your sensitive data, they could simply issue the *IC* command to use the command dataset directly, without going through your functions. And if your functions do anything to reduce the amount of data that each user is authorized to see from that file —for instance, if each user is only authorized to see his *own* data— all bets are now off. If he can find out the name of that command dataset, and if he is in the authorization list for any of the commands, he could side-step your functions and look at everything.

But how could he find the name of the command dataset? We have already established that APLSV prevents the users from unlocking the functions, and also prevents them from acquiring the names of anyone else's datasets. So what's the problem?

Well, we are not going to be using APLSV forever. We already announced (in July of 1984) that our plans are to migrate to APL2 under TSO. And the TSO environment doesn't protect dataset names. If the entire protection of your data comes down to the supposition that other users don't know the names of your datasets, you may be setting yourself up for problems on future systems. What would be nice to have would be a password on the TSIO dataset, as one extra measure of protection. While there is no password facility available for TSIO datasets *per se*, you can use symbolic parameters to create an equivalent capability. If you set up the name for the symbolic parameter as something obscure, and then assign it a value which would be necessary to create a complete, valid command, you will have created a facility in which that command cannot be used unless you know how to patch it together. Remember, a user who is authorized to use a command in a command dataset can't *see* that command, he can only execute it.

Here's how this procedure can be made to work:

Let's assume that the command that you issue against your command dataset looks like this:

```
IC DSN=¯123456 SALES.ACCESS(12)
```

...and the command that it executes currently looks like this:

```
SR DSN=¯123456 SALES.FILE
```

What can we do to protect this a little bit further? Well, if the command is changed to this...

```
S∧NEWYORK DSN=¯123456 SALES.FILE
```

...it would only be executable if the command was issued like this:

```
IC DSN=¯123456 SALES.ACCESS(12),∧NEWYORK=R
```

If that "*NEWYORK*" was omitted, the command would become simply "*S DSN=¯123456 SALES.FILE*", and wouldn't be valid.

A user could only supply that parameter if he knew the inner workings of your code and commands. Just knowing the name of the command dataset is no longer enough.

Notice that the real "*password*" portion of all of this is the name of the symbolic parameter just as much as its value. Here are some other examples of this technique:

Example 1:

Command dataset contains this: `IR DSN=¯123456 SALES.FILE,DISP=SH∧DOG`
User enters the command as this: `IC DSN=¯123456 GATE(7),∧DOG=R`
and TSIO sees command as this: `IR DSN=¯123456 SALES.FILE,DISP=SHR`

[If the user doesn't supply *DOG*, the command will default to *DISP=SH*, and fail.]

Example 2:

Command dataset contains this: `IR DSN=¯123456 MINE,CODE=∧ETC,∧ETC=Q`
User enters the command as this: `IC DSN=¯123456 GATE(8),∧ETC=A`
and TSIO sees command as this: `IR DSN=¯123456 MINE,CODE=A`

[If the user doesn't supply *ETC*, the command will default to *CODE=Q*, and fail.]

By using a "pseudo-password" procedure like this, you'll be ahead of the game, with an extra step of protection to keep the data secure even if the command dataset's name is compromised. ■

Creating and Maintaining IC Datasets

Workspace 1 *AIDS* contains lots of general-purpose functions for assisting you with utilitarian types of tasks which you may need to do, particularly those related to the use of TSIO for creating, initializing, renaming, or deleting datasets.

One of the main functions that is offered in 1 *AIDS* is the "*IC*" function. That function provides the ability to display, alter, and maintain TSIO command data sets. The function will guide you via menu selection and prompting for the various services you might require.

The following functions are available within the *IC* facility to manage command data sets:

Commands for using the IC facility:

SET, *DISPLAY*, and *DROP* ..... manage TSIO commands

ADD, *COPY*, *GIVE*, *REPLACE*, *DELETE*, and *PURGE* ..... manage user account numbers

ACCESS, *WHO*, *NO*, *LIST*, and *USERS* . provide information about the command dataset

HELP, *END* and *QUIT* ..... miscellaneous functions to help you to use the *IC* facility

> **"By indirections find directions out."**
>
> —Hamlet II, i, 63
> William Shakespeare [1564-1616]

Here's the action of each of those commands:

- *SET index-number*
  ...will prompt for a TSIO command and index number, if not supplied. That command will be put into the command data set at the selected index number, replacing any previous command at that index number.

- *DISPLAY index-number(s)*
  ...will display the selected TSIO commands.

- *DROP index-number(s)*
  ...will delete the selected TSIO commands. The command will be re-initialized and user authorization to it withdrawn.

- *ADD*
  ...will add one (or more) user(s) to one (or more) TSIO command(s). Previous users are unaltered. You will be prompted for command index numbers and user account numbers.

- *COPY*
  ...will add users of one TSIO command to another. You will be prompted for a *FROM* command index number and *TO* command index number(s). Previous user account numbers on the *TO* command(s) will be unaltered.

- *REPLACE*
  ...will replace users from one TSIO command to another. You will be prompted for a *FROM* command index number and *TO* command index number(s). Previous user account numbers on the *TO* command(s) will be deleted first.

- *GIVE*
  ...gives a user the same access that another user already has.

- *DELETE*
  ...will delete one (or more) user(s) from specified TSIO command(s).

- *PURGE user-account-number(s)*
  ...removes specified user account number(s) from the authorization matrix; therefore, it effectively removes authorization from all TSIO commands and removes any trace of the user from the command data set. Since only users not listed in the authorization matrix are represented by user number 0, *PURGE*d users will then be able to use commands with a user number 0.

  Note: It is redundant to precede *PURGE* with *DELETE*.

- *WHO index-number(s)*
  ...will display the user account numbers authorized to use specified TSIO commands.

- *NO index-number(s)*
  ...will display the specified TSIO command(s) and its authorized users.

- *LIST option*
  ...will list all TSIO commands in the data set and the user authorized to use each. You will be prompted for one of three options, if not supplied:

INUSE	will list only those entries containing commands or use
EMPTY	will list entries containing neither commands nor users
ALL	will list all entries

- *USERS*
  ...will list all user account numbers referenced in this data set.

- *HELP command*
  ...describes a selected command. You may type *HELP* followed by a command (for instance, "*HELP DROP*"), or just "*HELP*" and you will be prompted for the command that you wish to have described. A question mark, "*?*", may also be typed in response to any prompt, and additional instructions will be provided.

- *ACCESS user number*
  ...will prompt for the user number if not supplied. A list of the number of the commands that the user is authorized to access will be supplied.

- *END (or a response of* **ENTER***-key only)*
  ...will save your changes on the file and exit from the *IC* function.

- *QUIT (or a right arrow, "→", entered at any prompt)*
  ...exits from the IC facility without modifying the file.

●

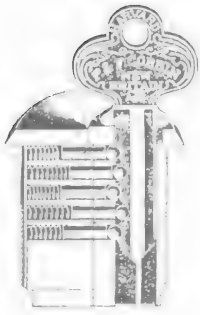
In response to any prompt:

- A question mark, "*?*", will provide more information.
- An empty response will normally return to the primary menu with no further action.
- A right arrow, "→", will interrupt the function.

For any function name or option, you may specify only as much of the word as is needed to uniquely identify it. For example: "*HE US*" is the same as "*HELP USERS*", but "*D*" is not enough (since it could mean *DELETE*, *DISPLAY*, or *DROP*).

New IC Datasets

If the IC dataset you try to use does not exist, you will be given the option of having it created. New IC datasets are always created as permanent datasets, using the "*ALLOCATE*" function (described on page 79). If you elect to have a new data created, you will be prompted for the number of users, the number of commands you expect to put into the file, and the security classification of the file. The numbers you give will be adjusted upward to completely fill the number of tracks your specifications require. ■



This discussion of command datasets is included for the benefit of the APL programmers who wish to understand the inner workings of the facility. It is ***not*** *recommended reading if you are simply a user of the facility, and not a programmer.*

Provision for enhanced security of datasets created under TSIO is embodied in the use of reserved datasets with controlled access. A dataset is said to be *reserved to a user* when the name of the dataset is qualified by the negative of the user's account number. This user can access the dataset freely, but other users can access it on a restricted basis only, subject to an explicit authorization table, as follows:

> A *command dataset* is a reserved dataset, but one which is available to other users solely for the purpose of letting a command be executed indirectly on behalf of those other users. The other users have access to the command dataset, and certain commands in them, only through being enrolled in an authorization matrix in the command dataset, as described later on.
>
> A dataset reserved to a particular user can be accessed by other users for reading and writing only indirectly, through the mediation of a command dataset reserved to that user.

Consider the case in which user `123456` wishes to authorize user `246810` for indexed reading of the reserved dataset `¯123456 SECRETS`. To accomplish this, user `123456` stores an image if the command `IR DSN=¯123456 SECRETS` as, say, the eleventh member of the reserved dataset `¯123456 GATEKEEP`. Subsequently, after sharing a control variable with TSIO in the normal way, user `246810` may submit a request for an indirect operation, using an IC command:

```
CTL←'IC DSN←¯123456 GATEKEEP (11)'
```

On receipt of this command, TSIO will first determine that `¯123456 GATEKEEP` has the proper format for a command dataset, then check the *authorization matrices* within it to determine whether user `246810` is permitted to utilize command form `11`. Only if both of these checks are satisfactory will TSIO execute the read command on behalf of user `246810`, who may then proceed with normal reading of `¯123456 SECRETS`.

If the dataset `¯123456 GATEKEEP` is not properly constructed as a command dataset, or if user `246810` has not been authorized to use the eleventh command, then TSIO issues the return code `2 1 - RESTRICTED COMMAND` to user `246810`.

A command dataset must have `CODE=A, RECFM=F, BLKSIZE=320`.

Record 0 of the command dataset must be an *integer* vector with the following elements:

[In origin 0]

[0]	First authorization matrix record number
[1]	Last authorization matrix record number
[2]	Maximum number of rows in authorization matrices
[3]	Last block allocated for authorization matrices
[4]	Number of authorized user entries, total for all authorization matrices
[5]	Creator's user number
[6 7 8 9 10 11]	Year, month, day of month, hour, minute, second of last update of the dataset

Referring to that initial record as "*REC*0", records 1 through "*REC*0[0]−1" of the dataset provide for indirect commands. From record "*REC*0[0]" on the records are authorization matrices of "32+*REC*0[0]−1" columns and of a number of rows no greater than "*REC*0[2]".

Columns 0 through 31 of the matrices contain the (32-bit) base two representation of user identification numbers. Columns 32 and on correspond to records 1 through "*REC*0[0]−1" of the dataset: if the element in row *I*, column 32+*J* is 1, the command in record *J* may be executed on behalf of the user identified in columns 0 through 31 of row *I*.

An entry for user 0 represents a general authorization for users other than those listed in the authorization matrices. A 1 in column 32+*J* of this row permits such users to execute the *J*-th command.

Each authorization matrix except the last must have the maximum number of rows as given by "*REC*0[2]". The rows of all the authorization matrices, considered as one matrix, must be in order by the base-two values of columns 0 through 31. The number of columns in the matrix must be a multiple of 8.

Command datasets are created and maintained by means of the function called "*IC*" in the workspace 1 *AIDS* on the Kingston APLSV system. The necessary instructions for their use are detailed on pages 92-94, and are also found under *ICHOW* in that workspace. ■

Semaphores: A General Enqueue/Dequeue Facility

When discussions of "security" come up, most users wince and consider that it means that they'll have to do something else to comply with Corporate Instruction 104A. Well, "security" can *also* imply *data integrity*; that is, ensuring that a user can't accidentally lose or damage data. One place where potential problems becomes very visible is in the simulataneous updating of a single file by many users. What's needed is a means of guaranteeing that a given operation by one user runs to completion before another user is allowed to start a new operation. In data processing circles, this is called an enqueue/dequeue facility.

"Semaphores" provide this general enqueue/dequeue facility for TSIO. They enable APL users, through the TSIO file processor, to notify each other that they wish to reserve certain resources. The users of a common resource agree on an integer value that will represent that resource and, before using the resource, check the enqueuing status of that value to see if they may have control of it.

When two or more users can modify the same file, problems arise if they attempt to modify the same record simultaneously. Assume that user `1234` has read a particular record, with the intention of modifying it. While he is modifying it, user `5678` reads the same record with the same intent. User `1234` writes his new version back to the file, but then user `5678` writes his new version also. What happens is that the changes made by user `1234` are lost, because his version is overwritten by user `5678`'s version.

What is needed is some programmable way for users to communicate with each other, so that all users but one may be inhibited from updating some record or group of records. *Semaphores* provide that means. During TSIO indexed operations (*IR* or *IRW*), they are controlled by the TSIO operation codes `2 3 4` and `5`; for example, *CTL*←`3 10`.

There are lots of applications in which the same dataset must be used asynchronously by a number of different users. To a certain extent this can be managed without conflict by appropriate use of the disposition parameter (such as "*DISP=SHR*" or "*DISP=OLD*"), but this alone may not be completely satisfactory. On the one hand, if the dataset is opened for exclusive use by one user (*DISP=OLD*), no matter how small the portion of the records actually involved, no other user can access any part of it until the dataset has been closed and reopened. On the other hand, if the dataset has been opened for shared use (*DISP=SHR*), except for the simplest case, in which all the sharers are only reading, some further mechanism is necessary to provide more dynamic control and finer resolution of the shared use.

Such a mechanism is provided by the operation codes `2 3 4` and `5`, which may be used on the control vector (*CTL*) when a dataset has been opened for indexed access with *DISP=SHR*. When one of these operation codes is used, the second element of the control vector may have any non-negative integer value. Except for zero, the significance of this value is completely arbitrary, although

commonly it may be a record number or a coded identification of a set of records.

TSIO Semaphore Operation Codes

Code	Key	Use	Effect	Action if in use
2	*n*	Exclusive	Immediate	Return code 15
3	*n*	Exclusive	When Available	Delay until available
4	*n*	Shared	Immediate	Return code 15
5	*n*	Shared	When Available	Delay until available

Note: "*n*" may be any integer from 1 through ¯1+2*31. The semaphore is released by assigning a key of 2 with *any* of the semaphore codes, or by assigning a new semaphore, or by breaking the sharing [through retraction, "*)LOAD*", "*)CLEAR*" or "*)OFF*"].

Operation codes 2 and 3 signify that the user wishes to have exclusive use of the facility denoted by the second element of the control vector, either immediately (2) or whenever it becomes available (3). The operation codes 4 and 5 signify that the user wishes to have non-exclusive use of the facility, – on a shared basis, simultaneously with other users – either immediately (4) or whenever it becomes available for such use (5). In any case, once the use of a facility has been acquired, the user is said to have an *exclusive hold* or a *shared hold* on that facility.

If more than one control variable has been attached to a dataset, each one may independently have a hold on a facility associated with that dataset. An existing hold associated with a control variable is automatically cancelled by any subsequent use of one of the operation codes 2 3 4 5, whether or not the new request is fulfilled. An existing hold can also be cancelled explicitly by using a zero for the second element of the control vector with any of these operation codes.

Consider for example the following functions, several instances of which are assumed contending to update records 100-120 of a dataset called "*EXAMPLE*":

```
    ∇ UPDATE;I
[1]  ⍝UPDATES RECORDS 100-120 OF THE 'EXAMPLE' DATASET
[2]   TOCTL 'IRW DSN=1234 EXAMPLE'
[3]   TOCTL 3 7
[4]   I←0
[5]  L1:→(120<99+I←I+1)/L2
[6]   DAT←RECORD I
[7]   TOCTL 1,I
[8]   →L1
[9]  L2:TOCTL 3 0
    ∇

    ∇ TOCTL X;E
[1]  ⍝PASSES CONTROL INFO TO SHARED VAR; READS RETURN
[2]   CTL←X
[3]   →(0=E←CTL)/0
[4]   'TSIO RESPONSE:  ',⍕E
[5]   ⍬
    ∇
```

The updating is performed by the function *RECORD*. The contender that achieves exclusive hold on facility 7 of the *EXAMPLE* dataset will next update records 100-120.

If a request for an immediate hold on a facility cannot be fulfilled because the facility is being held by another user, the control variable is returned with the value 15. Note that a request for exclusive use may be denied because another user has either an exclusive hold or a shared hold, and that a request for a shared hold may be denied only if another user has an existing exclusive hold. A request for a hold with codes 3 or 5, indicating that the user can wait, will remain in force until the facility becomes available for the type of hold requested, unless cancelled by a strong interrupt. The fulfillment of the request is signified by the value 0 in the control variable, which is, as usual, interlocked against reading until TSIO respecifies its value following receipt of the request.

Two points are worth noting here: First, the use of these operation codes *does not automatically guarantee protection* against conflicting use or other problems associated with shared facilities. It merely provides the potential for such protection to be incorporated in an application program. Thus, for example, there is no built-in constraint against the use of the 0 and 1 operation codes for reading or writing into a record which is otherwise part of a facility held by another user.

Second, because of the absence of such built-in constraints, the definition of the facilities denoted by the second element of the control vector when using an operation code of 2 3 4 or 5 is completely up to the applciation program, and need not refer in any way to the dataset in use. In such a case the dataset acts as a communication device with certain useful properties. The application will be making use of the built-in queuing facilities

of TSIO, as well as the properties of the operation codes, to control the use of some common resource.

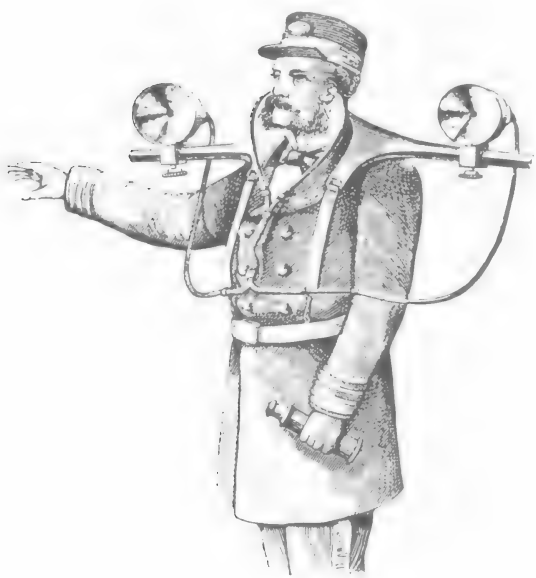
Shared Semaphores

Kingston APL consists of several separate systems, but don't worry: semaphores are shared between all of the systems.

Because of this, you don't have to be concerned about updates to your datasets occuring simutaneously on multiple machines. The simple answer is, "It handles it". Our goal with Kingston APL is always to present a "single-system image" [good IBM buzz-words] to our users. All workspaces, datasets, *and semaphores* are shared between all of the systems, so that it shouldn't matter which system you are signed on to.

●

Trivia Department: We might mention that, even though the APL designers have always conversationally referred to this facility as "semaphores", none of the APL manuals have ever called them that... in fact, they haven't called them *anything*. Admittedly, this makes it rather hard to find them in the index [...but you'll find them in *ours*.] ■



Who Is Using Your TSIO Datasets?

Workspace 1 *SMF* retrieves data showing a summary of accesses to each of your TSIO datasets during the past week (from early Saturday morning until early the following Saturday morning). The data is summarized by file name and accessing user-ID.

First enter *SMF* to retrieve the data,
then enter *SHOW ALL* to display it.

Data displayed will be:

- the ***account number*** that accessed a given dataset
- the number of times that he ***access***ed that file
- the number of ***reads*** (or writes) that he issued
- the number of ***bytes*** of data that he transferred
- the name of the dataset that he accessed (***DSN***)

Additionally, the "*SHOW*" function may be used in any of these forms:

SHOW DSN 'ABC'

shows accesses to all files whose names start with the string "*ABC*". Data is sorted by account-numbers. ("*DSN*" returns unformatted data, described later.)

SHOW USER 123456 234567

shows accesses by user accounts 123456 and 234567.

SHOW ACCESS SORTED DSN 'ABC'
SHOW READS SORTED DSN 'ABC'
SHOW BYTES SORTED DSN 'ABC'

Displays the data sorted by the indicated field (largest values first).

Other functions available are:

FILES

returns the names of each of your files that were accessed during the past week (this may not be all of your files).

USERS

returns a sorted list of each of the account numbers which accessed any of your files during the past week (use "*SHOW USER n*" to determine which files a particular account accessed).

Other Uses for This Information

Many applications have requirements for *logging* access to the data. Having this information about *who* is using each of your datasets may alleviate the requirement for writing your own code to do that logging. If your requirement is to simply capture the account number and number of times that the data is accessed, your own audit files may not be needed at all. This already does that.

Also in your favor is the fact that this facility is built into the system; therefore, it *cannot* be circumvented by some knowledgeable user, and you have the benefit of the logging being done by fast-running system code. Not bad, for free.

Finally, consider the uses of this data even beyond the obvious security uses. For example, let's say that you have slaved away in front of your terminal for months putting together an application that you *think* has been well-received by your users, but your management may have different ideas. Perhaps it would be advantageous to show them that your application *really is* being used (...if it is). This workspace may then become an important part of your business case. We use it for that all the time here in Kingston APL Support. To see how well-received a facility really is, there's nothing like gathering up real usage data.

Let's try it out:

```
      )LOAD 1 SMF
SAVED   9.17.44 09/05/84
```

The first thing that we need to do is to extract the data from the history files, and bring it into the workspace, so that we can look at it. That's done like this:

```
      SMF
***FILE DATE IS 01/26/85 THRU 02/02/85

***TO DISPLAY ALL THE DATA TYPE "SHOW ALL"
```

If we want to see the usage of all of our files, that's easy; just enter "*SHOW ALL*" (like it said). But let's assume that we have a *lot* of files. We don't necessarily want to wade through the usage statistics for *all* of them. This will show us the usage of each of our files whose names begin with "*SALES*":

(Let's assume that we're signed on with 123456.)

```
      SHOW DSN 'SALES'
[8]
ACCOUNT  ACC  READS      BYTES   DSN

  13579    2      6      1,920  ¯123456 SALES.ACCESS
 234567   12     36     11,520         ¨
 246810    2      6      1,920         ¨
 666666    3      9      2,880         ¨
1123456    2      6      1,920         ¨
  13579    2     43    182,879  ¯123456 SALES.FILE
 234567   12     33    140,349         ¨
 246810    2      8     34,024         ¨
1123456    2      8     34,024         ¨
```

Here is essentially the same inquiry, but with the results sorted by the number of accesses that each user made (and with totals):

```
      TOTAL SHOW ACCESS SORTED DSN 'SALES'
[8]
ACCOUNT  ACC  READS      BYTES   DSN

 234567   12     36     11,520  ¯123456 SALES.ACCESS
 234567   12     33    140,349  ¯123456 SALES.FILE
 666666    3      9      2,880  ¯123456 SALES.ACCESS
  13579    2      6      1,920         ¨
 246810    2      6      1,920         ¨
1123456    2      6      1,920         ¨
  13579    2     43    182,879  ¯123456 SALES.FILE
 246810    2      8     34,024         ¨
1123456    2      8     34,024         ¨
        ------ ------ ---------
 TOTAL:    39    155    411,436
```

But hold on a second; there's a suspicious entry here: user 666666 shows up as using the dataset called "*SALES.ACCESS*", but he *doesn't* show up as using the dataset called "*SALES.FILE*". Now,

there's nothing inherently odd about that, but let's suppose that our knowledge of the application points out that the "*SALES.ACCESS*" file is a *command dataset* (as described on pages 85-86), and further, let's assume that we know that there happens to be only one command in that dataset: a command which opens the "*SALES.FILE*" dataset. How is it that this user doesn't show up as using the "*SALES.FILE*" dataset and the other people do?

If user 666666 is *not* authorized to access the "*SALES.FILE*" dataset —that is, if he does not appear in the authorization lists within the "*SALES.ACCESS*" command dataset— any attempt on his part to use the facility will *log* the attempt against the command dataset. Here, the command dataset shows usage, because the system can only know whether or not he is on the authorized access lists by actually opening the command dataset and looking at those authorizations. He tried to access it three times, so those three attempts were logged. However, since he is *not* authorized to use that facility, there is *no* activity logged against the actual data file ("*SALES.FILE*"), because he was *not* able to open that file.

If you really want to see *all* of the unsuccessful attempts to access your files, that's easy; there's a "*FAILURES*" function provided for that purpose:

```
      SHOW FAILURES

UNSUCCESSFUL FILE-OPEN ATTEMPTS:

   ACCOUNT     DATE     TIME       DSN

     246810   01/27/85  23:33     -123456 BLIVIT.ACTUAL
     246810   01/27/85  23:33     -123456 BLIVIT.ACTUALS
     246810   01/27/85  23:34     -123456 BLIVIT.ACTUALS
     246810   01/27/85  23:35     -123456 BLIVIT.ACTUALS
     666666   01/30/85  08:33     -123456 SALES.FILE
     666666   01/30/85  08:34     -123456 SALES.FILE
     666666   02/01/85  07:57     -123456 SALES.FILE
```

Notice that user 666666 tried to access that sales file several times. But more suspicious-looking than that is user 246810... he wasn't even using a command dataset for his access attempts, so he couldn't have accessed the "*BLIVIT.ACTUALS*" file regardless of what he tried, but it's odd that he was trying this at 11:30 pm on a Sunday night. Perhaps you should ask him about this....

This information also makes it apparent that he misspelled the file name on his first attempt. There is no file under this account called "*FILE.ACTUAL*"; it's "*FILE.ACTUALS*" (with an "*S*") that he was after. His first attempt would have resulted in a TSIO return code of "12 – *DATASET NOT FOUND*", while the rest of his attempts would have resulted in "2 – *RESTRICTED COMMAND*". Realize, therefore, that you can trace more than just the attempted accesses to files that you own, you can also see the attempts to guess at names of files under your number even if they don't exist.

Here's another inquiry: it's similar to the first one, but this time we'll sort it by the number of bytes of data that each user transferred while using our files:

```
      TOTAL SHOW BYTES SORTED DSN 'BLIVIT'
[23]
ACCOUNT   ACC  READS      BYTES   DSN

  54321    26     26    338,780  ¯123456 BLIVIT.LOCATION
 123456    26     26    338,780
 123456    25     25    325,750  ¯123456 BLIVIT.USAGE
 123456    22     22    286,660  ¯123456 BLIVIT.PARTS
 123456    12     12    228,636  ¯123456 BLIVIT.SURVEY
 123456    14     14    182,420  ¯123456 BLIVIT.CONTROL
 123456    12     12    156,360  ¯123456 BLIVIT.ACTUALS
 123456     7      7     91,210  ¯123456 BLIVIT.INPUT
 123456     7      7     91,210  ¯123456 BLIVIT.PUBLIC
 112233     4      4     52,120  ¯123456 BLIVIT.USAGE
  54321     3      3     39,090  ¯123456 BLIVIT.DESIGN
 112233     2      2     26,060  ¯123456 BLIVIT.LOCATION
  54321     2      2     26,060  ¯123456 BLIVIT.PARTS
 112233     1      1     13,030  ¯123456 BLIVIT.ACTUALS
 112233     1      1     13,030  ¯123456 BLIVIT.CONTROL
  54321     1      1     13,030  ¯123456 BLIVIT.INPUT
 112233     1      1     13,030
 112233     1      1     13,030  ¯123456 BLIVIT.PARTS
 112233     1      1     13,030  ¯123456 BLIVIT.PUBLIC
 112233     1                    ¯123456 BLIVIT.DRAWINGS
 123456    14
 112233     1                    ¯123456 BLIVIT.NOTES
 123456    14
           ---    ---  ---------
TOTAL:     198    168  2,261,316
```

(Blank fields up here indicate that the file was opened but that *no* records were accessed.)

We can easily get a list of all of the users who used *any* of our files during the past week, like this:

```
      USERS
54321 13579 112233 123456 234567 246810 666666 1123456

      ρUSERS
8
```

And, of course, we can also look at the inquiry statistics for just a specified user (or for a list of users):

```
      SHOW USER 234567
[17]
ACCOUNT  ACC  READS      BYTES   DSN

 234567    6     18    234,540  _123456 AARDVARK
 234567    6     18    115,200  _123456 ACTUALS.FY1984
 234567   12     36     11,520  _123456 ARTWORK.ACCESS
 234567    6     54    509,868  _123456 ARTWORK.DESIGN
 234567    6                    _123456 BANANA.AAA
 234567   18     54     17,280  _123456 BANANA.ACCESS
 234567    6                    _123456 BANANA.KEYWORD
 234567    6                    _123456 BANANA.PRICE
 234567    5     15      4,800  _123456 CENTRAL.ORDERING
 234567    6     18      5,760  _123456 COST.CONTROL
 234567    6     [illegible]  135,708  _123456 GOOD.YIELDS
 234567   14     [illegible]   13,440  _123456 MAIN.ACCCESSS
 234567   14     [illegible] 8,065,570  _123456 MAIN.SYSTEM
 234567    6     [illegible]    5,760  _123456 PUBLIC.ACCESS
 234567    6     [illegible]  794,830  _123456 PUBLIC.DATA
 234567   12     [illegible]   11,520  _123456 SALES.ACCESS
 234567   12     [illegible]  140,349  _123456 SALES.FILE
```

For those of you who wish to write your own display functions, or use the data in some other manner, the structure of the data is explained in the workspace; "*)LOAD 1 SMF*" and type "*DESCRIBE*".

Realize that this data is a weekly compilation of the actual data that's gathered throughout the week. The actual data that's logged in the system includes such things as the time of day of each access. Since this would result in a potentially *huge* amount of data to report back to you through workspace `1 SMF`, we apply some data reduction first, and end up with what you see here. It's important for us to point out, though, that there *is* additional data available here.

Also realize that this report shows the accesses to the datasets which belong to a given account number; this does *not* show the access that a given user has made to *other people's* datasets (the reverse case).

The point to be made here is that the data to satisfy both of these needs *is gathered* each week. It is *not* generally available; in particular, it requires a fair amount of programmer activity here to sift through the data for all of the users and manually extract the entries that may apply to a given user or group of users. But at this point, it becomes a management call. If the information is *truly needed* —not just something of interest— it can be recovered.

Likewise, the only data reported back in this workspace is the information regarding the previous week. That's all that's kept on-line, primarily due to the volume of data. But entries from previous weeks are of course saved on tape. If there is a bona-fide need for the data —one which has been cleared through management and Security— data showing times of access, showing access by a given user, and showing activity during previous weeks *can* be gathered and reported to management.

As always, if you are concerned about potential breaches of security or mis-use of facilities, *get us involved.* ■

One method for viewing classified output
[albeit not necessarily recommended]

Section 7: Stringent Steps for Stringent Needs

Random Numbers: Understanding Random Link (⎕*RL*)

Over the years, a source of mystery to occasional users of APL has been the operation of the Random Link.[9] We have had some of our users call us at times, pointing out that there's a problem with the system, since it appears to be generating the *same* "random" numbers each time the workspace is loaded. Well, let's talk about it a bit.

Some people are adamant about the idea that there is really no such thing as a truly random number; everything is traceable back to *something*. We tend to variously agree *or* disagree with them, randomly, depending upon our mood....

In APL circles, that "something" that they speak of is the random link. It's the "seed" from which all of the random numbers grow. You can get right to the seed through ⎕*RL*. In a fresh workspace, ⎕*RL* has a value of `7*5`, or `16807`. It is used as a part of the calculation to determine what the next "random" number will be whenever the query function (denoted by "*?*") is used. And yes, we'll have to agree that these aren't *really* true random numbers... but we'll show how these "*pseudo*-random" numbers are even more useful than *real* random numbers (whatever *they* are).

---

9 Not quite so large a mystery as the *comparison tolerance*, perhaps, but an occasional mystery, nonetheless.

The *roll* function is a monadic function named by analogy with the roll of a die; thus ?6 yields a (pseudo-) random choice from ⍳6, that is, the first six integers beginning with either 0 or 1 according to the value of the index origin (⎕*IO*). For example:

```
      ⎕IO←1
      ?6
1
      ?6
5
      ?6
3
      ?6 6 6 6 6 6 6 6 6 6 6 6
4 2 1 5 5 6 3 4 5 1 1 4 5
      ⎕IO←0
      ?6 6 6 6 6 6 6 6 6 6 6 6
0 2 0 2 4 3 5 5 3 0 3 2 4
```

The domain of the roll function is limited to positive integers (selected from ⍳¯2+2*31).

The result of the roll function for any number ***n*** is approximately ***n***×⎕*RL*÷¯1+2*31. Realize that ⎕*RL* has to be assigned a new value for every random number that's generated.

But what happens when you re-)*LOAD* the workspace? Well, since ⎕*RL* has been stored there since your previous use of that workspace, it will have whatever value it had when you)*SAVE*d the workspace. If it's a workspace that you don't re-)*SAVE* (such as a Public Library workspace), the random link always starts at the same point when it's loaded. And if it hadn't been changed when the workspace was created, chances are it will quite possibly have the system default value of 16807. That being the case, the sequence of numbers that will be generated for a given series of numbers that you enter will be predictable:

```
      )LOAD SAMPLE
SAVED  19.12.47 10/25/84
      ?1000 1000 1000
132 756 459

      )LOAD SAMPLE
SAVED  19.12.47 10/25/84
      ?1000 1000 1000
132 756 459
```

Not too random, is it? But that's *good*, because that means that you now have a way to test programs which use random numbers, and duplicate your results.

Since programs don't remain in their test phase forever (well, some do....), how can you tell it to *not* do this anymore; in effect, to start generating *really* random numbers? Aha, *that's* what the random link is for.

```
      )LOAD SAMPLE
SAVED  19.12.47 10/25/84
      ⎕RL←+/⎕TS
      ?1000 1000 1000
18 92 868

      )LOAD SAMPLE
SAVED  19.12.47 10/25/84
      ⎕RL←+/⎕TS
      ?1000 1000 1000
23 885 763
```

Notice that we have set ⎕*RL* to a value which will be different each time that we use it. Here, the seven elements in the time stamp have been added up to produce a single number which is continuously changing.

In the next couple of articles, we will be showing code in which the random link is set to some unpredictable value, such as the summation of today's date (+/⎕*TS*), or the user's accumulated connect time so far this session (⎕*AI*[⎕*IO*+2]).

In particular, if we set ⎕*RL* to some particular value which only *we* know —that almost sounds like a password, doesn't it?— we can then take a simple numeric encoding of text (such as "⎕*AV*⍳*TEXT*") and pass it through the query function, yielding an extremely unpredictable —*but repeatable*— sequence of numbers. The next two articles will discuss the use of this basic concept to scramble or encrypt text. Since all of the complex number generation is built right in to APL in the form of ⎕*RL* and "*?*", this approach to data encryption can allow very simple APL functions to produce complex (and secure) encryption.

If you are interested in studying random number generation further, just go to any restaurant to observe bistromathics in action (briefly described overleaf). Or, you can refer to The APL Language Manual (GC26-3847) and read about both the *roll* function that we've discussed here, and the dyadic form, the *deal* function. ■

Bistromathics

"Bistromathics itself is simply a revolutionary new way of understanding the behavior of numbers. Just as Einstein observed that time was not an absolute but depended upon the observer's movement in space, and that space was not an absolute, but depended on the observer's movements in time, so it is now realized that numbers are not absolute, but depend on the observer's movement in restaurants. ...

And so it was only with the advent of pocket computers that the startling truth became finally apparent, and it was this:

Numbers written on restaurant bills within the confines of restaurants do not follow the same mathematical laws as numbers written on any other pieces of paper in any other parts of the Universe.

This single fact took the scientific world by storm...."

—from *"Life, the Universe and Everything"*
© 1982 by Douglas Adams
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Data Scrambling

One step short of real data encryption is data "scrambling". Scrambling is simply mixing up the order of the characters that you're working with, forming an "anagram" of sorts. Some of you may work with anagrams for relaxation: you know that they can be solved —visually— with no computer equipment. So this technique should not be thought of as being a very secure approach... in particular, *this is not a replacement for encryption* in places where encryption is required. But for situations in which you may simply want to make the data difficult to read casually, this is a choice that you have. (On the plus side, scrambling the data is much quicker —and therefore cheaper— than encrypting the data.)

```
    ∇ SETUP
[1]   ⎕RL←11223344
[2]   MUV←47?47
    ∇
```

This is the "password" for your data. The number can be whatever you wish, from 0 to two less than 2^{31} (stated in APL as `¯2+2*31`). Whatever value you choose, keep it hidden from your users.

This is called our "mix-up vector"... the number that you choose for this is the range through which the data will be scrambled. In this example, each group of 47 characters will be scrambled. No character will be moved further than 47 characters. Certainly, a larger value is preferable. Of course, since you will need to keep *MUV* hidden, the users of your application won't even know its size; that's part of its protection.

```
      SETUP

      MUV                    ←—Data will be scrambled to these positions
8 47 25 35 1 31 4 42 30 41 10 14 3 11 23 17 19 40 46 32 29 16
       36 38 21 2 9 34 44 45 39 24 12 7 20 5 27 37 15 26 33 43
       13 22 28 6 18

      ⍋MUV                   ←—and this will unscramble it again
5 26 13 7 36 46 34 1 27 11 14 33 43 12 39 22 16 47 17 35 25 44
       15 32 3 40 37 45 21 9 6 20 41 28 4 23 38 24 31 18 10 8 42
       29 30 19 2
```

Obviously, both the value of ⎕*RL* and the *MUV* variable should be localized in your code, so that users can't get to them. These two values protect your data. So, here's the header line of our main function for this application:

```
    ∇ MAIN;⎕IO;MIX;XIM;MUV;⎕RL;SALES;DATA;MANAGER;REPORT;[illegible]
[1]   ⎕IO←1
[2]   ⎕RL←666
[3]   MUV←137?137
[4]
```

These four items have been localized so that we don't have to worry about little prying fingers tampering with the security measure.

```
    ∇
```

Here are the scrambling and unscrambling functions, named "*MIX*" (for the function that does the mixing up of the characters, and "*XIM*" (for the function that does just the reverse of *MIX*):

```
      ⎕RL←11223344
      MUV←47?47

    ∇ Z←MIX T;⎕IO
[1]   ⍝SCRAMBLES THE TEXT... SEE ALSO 'XIM'
[2]   T←(-+/∧\⌽T=' ')↓T          ←—Removes trailing blanks
[3]   T←T,(⍴MUV)↑''              ←—Adds enough trailing blanks to make
[4]   T←((⌊(⍴T)÷⍴MUV),⍴MUV)⍴T      the length an even multiple of ⍴MUV
[5]   Z←,T[;MUV]                    (here, it's 47)
    ∇
```

Moves columns into *MUV* order

```
    ∇ Z←XIM T;⎕IO
[1]   ⍝UNSCRAMBLES THE TEXT... SEE ALSO 'MIX'
[2]   T←((⌈(⍴T)÷⍴MUV),⍴MUV)⍴T ←—Re-shapes into a matrix
[3]   Z←,T[;⍋MUV]                ←—Re-orders the columns
[4]   Z←(-+/∧\⌽Z=' ')↓Z          ←—Removes trailing blanks
    ∇
```

Here's some sample text for us to scramble:

```
      TEXT←'OPEN THE POD BAY DOORS, PLEASE, HAL.'

      MIX TEXT                   ←—This scrambles the text
E PLO,N E PBEO, O   SY. RP A    DHO E AHL  SATD

      NEW←MIX TEXT               ←—Realize that a given piece of text will
                                    always get scrambled into the same new
                                    order, since the value of MUV is fixed.
      NEW
E PLO,N E PBEO, O   SY. RP A    DHO E AHL  SATD

      XIM NEW                    ←—This unscrambles the text
OPEN THE POD BAY DOORS, PLEASE, HAL.
```

The value that you choose for the length of "*MUV*" shouldn't be too small, because a very small value will only allow the data to be re-ordered within that small range; for instance, if the value was 2, the only "scrambling" that would be done is that adjacent pairs of characters *might* be interchanged (or, depending upon the value of *⎕RL*, they might not...) — if you call that scrambling!

```
      ⎕RL←1
      MUV←2?2                ←—This is way too small!

      TEXT
OPEN THE POD BAY DOORS, PLEASE, HAL.
      MIX TEXT
PONET EHP DOB YAD OOSR ,LPAEES ,AH.L ←—There is no
                                       security in this!
```

(...Anagrams for people in a hurry?)

Likewise, the value can't be huge, since the length of the output of the *MIX* function will be a multiple of the length of *MUV* (causing small chunks of text to be padded to cumbersome lengths), and since *MUV* itself has to reside in the workspace. A really *huge* value would be more likely to plague you with *WS FULL* problems. There are no hard and fast rules here. If you have a use for this technique, the optimal values will become clear through experimentation with your own data.

Additional Reading

If you are interested in the subject of data scrambling and encryption (and who isn't?), a fascinating book that you should certainly acquire is *"Mr. Babbage's Secret: The Tale of a Cypher—and APL,"* by Ole Immanuel Franksen (published by Strandbergs Forlag, Birkerød, Denmark, 1984).

This entertaining book discusses such topics as the cracking of enciphered advertisements from the "agony columns" of Victorian newspapers. The book was first made available at the APL84 Conference in Helsinki, Finland, June 11-13, 1984 (sponsored by FinnAPL and ACM SIGAPL).

Dr. Franksen's accounts of Charles Babbage's propensity towards the solving of encrypted classified ads in the newspapers —manually—in the *mid 1800's*— may give you pause for thought about the likelihood of ever being able to provide *absolute* protection for anything that a very skilled person may want to acquire. APL solutions are given. ...Order it. You'll learn about *"cyphers"* and APL and a whole lot more. And you'll have fun doing it. ■

Data Encryption

Encryption for Data Transmission

For data transmission of IBM Confidential Restricted data, Corporate Security Instruction #104A requires that encryption be used "except when transmission is entirely via wire (no microwave or satellite) and the wire remains within an IBM location."

Any data transmission of Confidential Restricted data to and from your terminal will need to be on encrypted lines. Some lines are already encrypted. To find out if the lines you are using are encrypted, or if you need to have some lines encrypted, call the Help Desk at T/L 695-1234... they can get you in touch with the Line Services group.

Realize that the transmission of data over VNET (through the use of workspaces `1 TRANSMIT` or `31 VNET`) is *not* always encrypted.

Encryption for Data Storage

Workspace `10 SECURITY` offers functions for encryption and decryption of your APL data. Obviously, running all of your data through *any* conversion function will cause more compute time to be used. If you plan to make *heavy* use of these functions, you should plan to run sufficient timing tests so that you can determine if this is a reasonable approach for your particular application.

There are two functions provided for converting your data; they are called "*ENCODE*" and "*DECODE*". Let's take a look at them:

```
    ∇ Z←KEY ENCODE IN;ALF;⎕IO;⎕RL ⟵ Localize Origin and Random Link
[1]  ⍝ENCIPHERS CHARACTER RIGHT ARG, BASED UPON 'KEY' IN LEFT ARG
[2]    ⎕IO←0                          ⟵ Set the Index Origin
[3]    ALF←⎕AV                        ⟵ Atomic Vector is our alphabet
[4]    ⎕RL←(ALF⍳KEY)+.×⍳⍴KEY          ⟵ Calculate ⎕RL value from key
[5]    Z←,(⍴ALF)⍴(⍴,IN)?1000000       ⟵ Select a repeatable random number
[6]    Z←,(⍴ALF)⍴(ALF⍳,IN)+Z          ⟵ Add that to the text's index values
[7]    Z←ALF[Z]                       ⟵ Select characters from our alphabet
[8]    Z←(⍴IN)⍴Z                      ⟵ Reshape result to match the input
    ∇

    ∇ Z←KEY DECODE IN;ALF;⎕IO;⎕RL
[1]  ⍝DECIPHERS CHARACTER RIGHT ARG, BASED UPON 'KEY' IN LEFT ARG
[2]    ⎕IO←0
[3]    ALF←⎕AV                        Here's the mirror-image process
[4]    ⎕RL←(ALF⍳KEY)+.×⍳⍴KEY
[5]    Z←,(⍴ALF)⍴(⍴,IN)?1000000
[6]    Z←,(⍴ALF)⍴(⍴ALF)+(ALF⍳,IN)-Z  ⟵ This time we subtract it from
[7]    Z←ALF[Z]                           the index values of our text
[8]    Z←(⍴IN)⍴Z
    ∇
```

Let's try them out with some familiar text:

```
      TEXT←'OPEN THE POD BAY DOORS, PLEASE, HAL.'

      NEW←'SECRET' ENCODE TEXT
      NEW
_"○∊N⍒`●>$}C9₃⊂ ___s²X²gϕ!*U_?V⊖"<⁹_
```

←—That's *relatively* unreadable.... Do you think you could guess the original text from this?

The output may sometimes *look* a little bit shorter than the original text, just because there may be some *undisplayable* characters here, but the input and output are the same length:

```
      ⍴TEXT
36
      ⍴NEW
36
```

This will convert the encrypted data back to plain text:

```
      'SECRET' DECODE NEW
OPEN THE POD BAY DOORS, PLEASE, HAL.
```

...just be sure that you *don't lose that key!*

```
      'SECRETS' DECODE NEW
_Y|ϕa_
F▽~\¬(_³ce⍟k●⁻):ιω⁶gt≠⁸¬¬Yn
```

←—Changing the "key" even trivially will produce output that bears absolutely no resemblance whatsoever to the original encrypted output.

```
      'SECRETLY' DECODE NEW
]__L⁸~__⊤Zy∧
∧\⊖₃z__'⍒ZFQss$⍎Vy _K__

      'SECRETS' ENCODE TEXT
i≤⍋≤⍒ qUbWsl+N J⍒G⍎
- \5u[∘jB↑R

      'SECRETLY' ENCODE TEXT
\U÷O3÷[22|I∆%¢⊂¨x>¨F⍒A/\
```

Compare this with the equivalent example using the "scrambled" approach, back on page 114... which approach do *you* think looks more secure?

Additional Reading

Additional reading on the subject of both scrambling and encryption is available in a paper by Bill Hillman, entitled "*Information Security Issues in an APL Application*", from the Conference Proceedings of the APL84 Conference in Helsinki, Finland (sponsored by FinnAPL and ACM SIGAPL). The proceedings were published as the *APL Quote Quad*, Volume 14, Number 4, dated June 1984. ■

Shared Variables

Two otherwise independent concurrently operating processors can communicate, and thereby be made to cooperate, if they share one or more variables. Such *shared variables* constitute an interface between the processors, through which information may be passed to be used by each for its own purposes. In particular, variables may be shared between two active APL workspaces, or between an APL workspace and some other processor that is part of the overall APL system, to achieve a variety of effects including the control and utilization of devices such as printers, card readers, magnetic tape units, and magnetic disk storage units.

In use in an APL workspace, a shared variable may be either global or local, and is syntactically indistinguishable from ordinary variables. It may appear to the left of an assignment, in which case its value is said to be *set*, or elsewhere in a statement, where its value is said to be *used*. Either form of reference is an *access*.

At any instant a shared variable has only one value, that last assigned to it by one of its owners. Characteristically, however, a processor using a shared variable will find its value different from what it might have set earlier.

Consider the following simple example of sharing the variable *V* between two users 1234 and 5678:

User 1234:	User 5678:
`      5678 ⎕SVO 'V'`	
`1`	
	`      1234 ⎕SVO 'V'`
	`2`
`      V←5`	
	`      V←3×V*2`
`      V`	`      V`
`75`	`75`

The relative sequence of events in the two workspaces, after sharing, is significant; for example, had that last access of *V* by 1234 in the foregoing example preceded the setting by 5678, the resulting value would have been 5 rather than 75.

A given processor can simultaneously share variables with any number of other processors. However, each sharing is bi-lateral; that is, each shared variable has only two owners. This restriction does not represent a loss of generality in the systems that can be constructed, and commonly useful arrangements are easily designed. For example, a shared file can be made directly accessible to a single control processor which communicates bi-laterally with (or is integral with) the file processor itself. In turn, the central processor shares variables bi-laterally with each of the using processors, controlling their individual access to the data, as required.

Access sequence disciplines are also imposed on certain of these variables, although one effect of this was noted; namely, variables like the time stamp accept any value specified, but continue to provide the proper information when used. The discipline that accomplishes this effect is an inhibition against two successive accesses to the variable unless the sharing processor (the system) has set it in the interim.

Distinguished Names for Controlling Shared Variables

Symbol	System variable	System function with monadic usage	System function with dyadic usage	Function or Variable Name
□SVC		●	●	Shared Variable Control
□SVE	●			Shared Variable Event
□SVO		●	●	Shared Variable Offer
□SVQ		●		Shared Variable Query
□SVR		●		Shared Variable Retraction
□SVS		●		Shared Variable State

For formal definitions of all of the system functions and system variables, refer also to *The APL Language Manual (GC26-3847)* and to *An Introduction to APL2 (SH20-9229).*

■

The Ultimate Step: Creating a Server Machine

First, What Is It?

We'll start with an analogy: You have all used TSIO (whether you realize it or not). TSIO is an "auxiliary processor" (a processor that runs independently of APL) which allows APL to communicate with the system that it's running on, for the purpose of reading and writing files, sending data to a high-speed printer, etc. It happens that TSIO is written in System/370 Assembler code, but it could be written in any language. It could, for instance, have been written in APL code.

In analogous fashion, a "Server Machine" is an APL account which keeps an APL function running all of the time, looking for incoming shared-variable offers which might be made from other users' accounts.

Let's consider a scenario:

Imagine that you have this special application set up and running under your account number. Phil in Punxsutawney needs to read some data from your database, but you *know* Phil, and you know that he may try to burrow into more than he is authorized to see if you give him access to it. So instead, you give him a workspace which shares a variable with your account; meanwhile, your account has been signed on and waiting for him to use it since last winter. When Phil finally *does* share a variable with your account (using *user-to-user shared variables*), the only thing that he assigns to the shared variable is a short character string which consistutes a command for your application. Your account then looks at that command, looks up his account number in a table to make sure that he is an authorized user, and looks up the information for him. Your functions would have to have established some sort of command language to use for letting Phil order what he needs. Notice that the inquiry is taking place in *your* workspace, not his. (Notice also that you are paying for it.)

Since the functions that are reading the file aren't even in Phil's workspace, there is no chance of him modifying them and thwarting your security checks. When you reduce the data to just the portion that he should see, you simply feed it back to him through the same shared variable.

Why You Might Want to Use This Approach

You may want to consider this sort of approach when you have an application which has various types of data in one file, and where you may want to limit some users to only seeing some of that data. If you do all of the data manipulation within their workspace, consider the limitations: the function that they call must be a single stand-alone function with no sub-routines (or else they could modify some of the sub-functions). Also, the file would have to be opened each time that the user made any inquiry. That's very time-consuming and wasteful; but the alternative is to have the shared variables be global variables in the workspace, and if that's the case, there's nothing to prevent a knowledgeable user from simply assigning his own values to the

control variable and reading the file directly. At that point, all bets are off regarding security.

If you are in this sort of position in the design of an APL application, then maybe you should consider a Server Machine.

We only say *"maybe"* because the creation and use of a server machine is not without a price (...what is?), and the price just may not be worth it for your data... only you can answer that one. Also realize that this step is a large one, and requires an in-depth knowledge of APL to even consider pursuing it. All of the details will *not* be spelled out here.

Why You Might NOT Want to Use This Approach

You should consider what it implies in the way of resources to run such a machine. In order to offer service to other users through a server machine, you need to have the server machine account signed on and available anytime that any of your users might want to use it. Also, a separate server machine would have to be run on *each* of the four APL systems here in Kingston if your users are going to be able to access it from whichever machine they happen to sign on to. [Yes, we realize that the lack of user-to-user shared variables *across systems* is a limitation here, and we are working to remove that restriction. When that's finally corrected, our goal of presenting a *"single system image"* to you will be resolved.] The responsibility of starting and stopping the server machines each day would be up to you, and moreover, their connect and compute time would be billed to you.

However, since all of the data manipulation is being done in your own workspace (rather than your user's workspace), the security of this approach can't be beat.

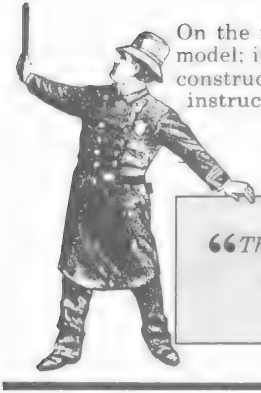
...It's just not for everyone.

Since the operation of a server machine requires extra accounts to be signed on all of the time (on each of several systems), you might realize that *we* here in APL Support are the most likely candidates for using such a facility... and as yet, we haven't taken that step on any of our public offerings. It is a valid approach, and it certainly can be used by any of you. But you do need to consider the costs and implications.

●

On the next page is a sample server machine. It's a bare-bones model; it *does* work, but in actual production, you would want to construct a much fancier machine. This one is shown here for instructional purposes only.

●



> *"They Also Serve Who Only Stand And Wait."*
>
> —John Milton,
> from *On His Blindness* [1652]

A Sample Server Machine

```
    ∇ START;⎕IO;X;SVLIST;SVNAMES
[1]  ⍝START UP A SHARED VARIABLE SERVER
[2]   ⎕IO←1
[3]   INITIALIZE          ←—Open files, set variables, etc.
[4]  LOOP:RETRACTS        ←—Look for retracted variables.
[5]   OFFERS              ←—Look for newly offered variables.
[6]   PROCESS SETS        ←—Look for and process set variables.
[7]   ⎕SVE←3600           ←—Wait for a shared variable event such
[8]   X←⎕SVE                  as a retract, offer, or set.
[9]   →LOOP
    ∇
    ∇ INITIALIZE
[1]  ⍝PUT ANY INITIALIZTION CODE HERE:  OPEN FILES, SET VARIABLES, ETC.
[2]   SVNAMES←'A',10 1⍴'ABCDEFGHIJ'  ←—Set up list of possible names.
[3]   SVLIST←SVNAMES,10 10⍴'0'       ←—List of names and account numbers.
    ∇
    ∇ RETRACTS;VARS;B;X
[1]  ⍝LOOK FOR RETRACTED VARIABLES
[2]   B←2≠⎕SVO VARS←SVLIST[;⍳2]      ←—Who has retracted?
[3]   X←⎕EX B/VARS                   ←—Retract and erase variable.
[4]   SVLIST←(~B)/SVLIST             ←—Remove variable name and account
    ∇                                     number from list.
    ∇ OFFERS;ACCTS;VARS;X;I;J;NAME
[1]  ⍝LOOKS FOR OFFERS, ADD TO "SVLIST"
[2]   ACCTS←⎕SVQ⍳0                   ←—Get list of accounts which made offers
[3]   I←0
[4]  L1:I←I+1                        ←—Loop through list of account numbers...
[5]   →(I>⍴ACCTS)/0
[6]   VARS←⎕SVQ ACCTS[I]             ←—Get list of variables offered by one user.
[7]   J←0
[8]  L2:J←J+1                        ←—Loop through list of variables
[9]   →(J>1↑⍴VARS)/L1                    offered by each account.
[10]  NAME←SVNAME                    ←—Get a unique name for shared variable.
[11]  →(0∈⍴NAME)/L2                  ←—Ignore this offer if no name is available.
[12]  X←ACCTS[I]⎕SVO NAME,' ',VARS[J;] ←—Fulfill the offer.
[13]  X←1 ⎕SVC NAME                  ←—Set shared variable interlock.
[14]  SVLIST←SVLIST,[1]NAME,(10⍴'0')↑ACCTS[I]  ←—Add name and account
[15]  →L2                                          number to list.
    ∇
    ∇ R←SVNAME;B
[1]  ⍝PICK A UNIQUE SHARED VARIABLE NAME
[2]   B←∧/SVNAMES∨.≠⍉SVLIST[;⍳2]
[3]   R←B/SVNAMES
[4]   R←,R[⍳1⌊+/B;]          ←—Pick only one name, or empty vector if none.
    ∇
    ∇ Z←SETS;S
[1]  ⍝RETURNS LIST OF SET VARIABLES
[2]   S←⎕SVS SVLIST[;⍳2]             ←—Get status of all shared variables.
[3]   S←S∧.=0 1 0 1                  ←—Which ones have been set?
[4]   Z←S/SVLIST                     ←—Return list of set variables.
    ∇
    ∇ PROCESS VARS;I
[1]  ⍝PROCESS SHARED VARIABLES SET BY USERS
[2]   I←0
[3]  L1:I←I+1
[4]   →(I>1↑⍴VARS)/0
[5]   ⍎VARS[I;⍳2],'←SERVE ',VARS[I;⍳2] ←—Read, service, and set variable.
[6]   →L1
    ∇
    ∇ Z←SERVE R
[1]  ⍝PUT THE CODE TO SERVE THE USER HERE
[2]   Z←⍴R       ←—Just as an example, the shape of the variable is returned.
    ∇
```

Additional Reading

If you wish to pursue the topic of Server Machines further, you can find additional thoughts in a couple of papers which have been published internally within IBM on this subject. Neither one of these papers directly addresses the subject of server machines under APLSV, but each of the papers may give you ideas on the subject.

The first paper is by Achim Zink (IBM, Mainz, Germany), and is entitled "An APL Secure Machine Facility under VM/370", published in the Proceedings of the 1978 IBM Symposium on APL (Volume I, page 363); this symposium was held at Foothills College, Los Altos Hills, California, March 28-30, 1978. The proceedings book may be available in many of the IBM site libraries.

Another such discussion was presented at the APL ITL Meeting in San Jose, California, October 16-19, 1984. The paper was entitled *"APL2 Server Machine Using GSVP,"*[10] by Marty Ziskind[11] (IBM, Endicott, NY). The paper is available from the author. ■

10 "GSVP" is the "Global Shared Variable Processor," which allows shared variables to extend between physically separate systems.

11 Notice that people who write about Server Machines commonly have names beginning with "Z". Someone could probably do their doctoral thesis on this.

Section 8: Protecting Your Data from Batch

RACF and Batch Jobs

By default, *all* of the datasets that are created through TSIO are protected from batch access. That is, batch jobs cannot access your TSIO data unless you take specific steps to allow such access. This protection is invoked by the "Automatic Data Set Protection" (ADSP) attribute within the system's "Resource Access Control Facility" (RACF). ADSP causes all newly-created datasets to be protected unless you explicitly specify otherwise.

If you write an application, and you have a need to use a batch job to access some of your TSIO datasets (for example, to load datasets onto the system), we strongly recommend that you contact us while you are still in the planning stages for such an application. We may be able to suggest alternatives which could simplify your operation (such as, in this case, using VNET or wideband for receiving your data).

Assuming, however, that you decide that you do have some special need for batch jobs, the RACF user-IDs that will be accessing the datasets used in the application will have to be given RACF permission to use them. To do this, "*)LOAD 1 AIDS*" and type "*RACFPERMIT*". This function will prompt you for the dataset name and the RACF user-ID. You will also need to determine what kind of access they should have. They may have one of four types of access:

0 = NONE	No access allowed (except by the owner) (i.e. delete RACF authorization)
1 = READ	Read access only
2 = UPDATE	Read/Write access
3 = ALTER	Read/Write access plus Rename/Delete authorization

To see who has been previously permitted, use the "*RACFLIST*" function. Enter the name of the dataset(s) you wish to see. The function will return the RACF user-IDs which can access that dataset and what type of access they have.

```
        )LOAD 1 AIDS
  SAVED  10.22.11 08/20/84

        RACFLIST
  >>>DATASET NAMES?  (ONE PER LINE)
  ? ¯123456 SHARED.PROJECT
  ? _

  RACF AUTHORIZATIONS FOR DSN=¯123456 SHARED.PROJECT

  RACF USER ID      ACCESS LEVEL      ACCESS COUNT
  A123456           READ                         9
```

To change the authorization:

```
       )LOAD 1 AIDS
SAVED  10.22.11 08/20/84

       RACFPERMIT
>>>DATASET NAME?  ¯123456 SHARED.PROJECT
>>>RACF USER ID (OF BATCH JOB)?  A123456
RACF ACCESS LEVELS:
   0 = NONE     (NO ACCESS ALLOWED)
   1 = READ     READ ACCESS ONLY
   2 = UPDATE   READ/WRITE ACCESS
   3 = ALTER    READ/WRITE ACCESS PLUS RENAME/DELETE
>>>ACCESS AUTHORITY (0, 1, 2, OR 3)?  3
*** RACF USER [A123456] AUTHORIZED FOR [ALTER] ACCESS
    TO DSN=¯123456 SHARED.PROJECT
```

Glossary

In case you feel rather like an outsider because of some of the terminology used in this manual, let's try to get together on it. Here are a few of the terms that we often consider to be common-knowledge (but may not be).

[Items marked with "●" also appear elsewhere in this glossary.]

alpha-numeric: A sequence of characters consisting of any mixture of letters and numbers (such as "*ABC*123").

APL: The name of the programming language that is available on Kingston system and discussed in this manual; named for the book entitled "*A Programming Language*" (K.E. Iverson, published by Wiley and Sons, 1962).

APLSV: The particular "brand-name" of APL● that's available on the Kingston system and discussed in this manual; "APLSV" stands for "*APL with Shared Variables*" (a means of managing data).

access code: This is the first letter of the name that displays when you sign on to APL (that's the "*K*" in the "*KJDOE*" name in the sign-on message on page 27.) Contrary to public opinion, it is *not* there simply for the purpose of misspelling your name; it's a code that determines which of the telephone lines you are authorized to use when you dial into the system. For more information, "*)LOAD 1 PHONES*".

account number: This is the numeric portion of your APL sign-on number. By local convention on the Kingston system, it normally (but not necessarily) matches your IBM employee serial number.

batch processing: When you sign on to APL, you type in a statement and you get a result printed back at your terminal. This result will help you to decide what you may want to type in next. This is *interactive* processing. The opposite approach to this is to gather up all of your inputs in one "batch", and send the entire list of requests to a system for processing. You would then get back your results at some later time. An example of this type of processing is the APL facility called "DEFER"● (in workspace *30 DEFER*).

command dataset: This is a dataset● containing only commands and list of the account numbers which are authorized to execute the various commands. This mechanism provides a secure means of allowing scattered users to access your data in a controlled fashion. The concepts behind this scheme is discussed in detail on pages 85-91, and the functions which allow you to maintain command datasets are described in detail on pages 92-94.

compute time: This is the amount of time that APL has actually spent performing work, or doing calculations, for *you* as opposed to working for the scores of other users who may also currently be signed-on to the same computer. This time is normally a small fraction of the time that you were connected to APL. Printing output at the terminal, for example, takes very small amounts of compute time. [Also called *CPU time*]

connect time: This is the amount of time that your APL account was signed-on to (or connected to) APL. If you sign on at 3 pm and off at 4 pm, you've used an hour of connect time.

CPU: CPU stands for Central Processing Unit... it is the part of the computing system that actually does the computing, as opposed to "peripheral" equipment, such as printers and storage devices.

dataset: A dataset is an orderly collection of data stored on disk. In APL, it is *not* the same as a workspace. Refer to page 73 for a complete discussion of this topic.

DEFER: See "batch".

expunge: This refers to the dynamic erasure of functions● or variables●. The "`)ERASE`" command also provides an erasure facility, but it may not be issued from within a function. "`⎕EX`" is a very similar facility, and may be issued from within your code. Refer to page 51.

file: See "dataset".

function: The term that APL uses for "program". Often abbreviated as "*fn*".

hacker: "The hacker stereotype is a pudgy male with a fish-belly-white complexion who swills soft drinks, lives on candy bars and spends most of his waking hours in front of a terminal, playing games or trying to penetrate Defense Department Networks." —*Time Magazine, May 1983*

Hotline: Kingston APL offers the convenience of having a single phone number for getting in touch with anyone in APL Administration, programming, and management. If you know precisely who to call, you can save a step by calling them directly. But if you're ever not sure who can answer your questions, just call the APL Hotline, T/L 695-1234 (or outside, on 914-385-1234). [Also known as the ***Help Desk***]

IC dataset (Indirect Command dataset): See "command dataset".

interactive: The opposite of batch... see "batch".

latent expression: [`⎕LX`] Causes a workspace to "come up running" when it's `)LOAD`ed. Refer to The APL Language Manual (GC26-3847) for details of usage, and see the discussion in this manual on page 48.

library: The set of workspaces● that you have saved is called your library. Each workspace is identified by your account number● and the name that you assign to it. In referring to workspaces in your own library, the account identification may be omitted; your own identification is then supplied automatically.

problem number: This is your APL billing number. Each group, typically a department, has a number assigned, which groups the charges together under one bill. The problem number is six characters long, mixed alphanumeric. It is in the form of "123XAK". The first three characters are usually (but not necessarily) your department number.

Your *problem number manager* is the manager who receives the billing for your APL usage. Most often (but not necessarily), he is the department manager. Both your problem number and your problem number manager are listed in workspace `1 ACCOUNT`.

RACF: "Resource Access Control Facility"; this is a security package offered with the host system (MVS), which controls who can get to each of the datasets on the system.

reserved dataset: This is a dataset● which may only be accessed by its owner or by users specifically authorized by the owner. A reserved dataset is a secure means of storing sensitive data. Refer to pages 85-91.

right-paren: The right parenthesis —or closing parenthesis— ")" is always used to preface a system command●; used when signing on [as in ")123456:*ABCDEF*"] or ")*OFF*", or to ")*LOAD*" or ")*SAVE*" a workspace●.

system command: An APL system recognizes two broad classes of instructions, "expressions" and "system commands". System commands control the initiation and termination of a work session, saving and reactivating copies of a workspace, transferring data from one workspace to another, and a variety of tasks within the workspace.

System commands can be thought of as being a sort of link to the outside world, allowing the users of APL functions and variables access to the environment which may not be defined as properly being a part of the APL Language.

System commands can be invoked only by individual manual entries from the keyboard and cannot be executed dynamically as part of a defined function. They are distinguished from APL statements in that they are always prefixed by a right● (closing) parenthesis.

TSIO: TSIO stands for "Time-Shared Input/Output"; it's an "auxiliary processor" (a processor that runs independently of APL) which allows APL to communicate with the system that it's running on, for the purpose of reading and writing files, sending data to a high-speed printer, etc.

variable: In APL, an assignment of data to a name creates a variable, so named because its value may be varied at any time by simply re-assigning it. For example, "*T*←'*SOME TEXT*'" stores nine characters under the name "*T*", and "*R*←2+2" stores the result of a calculation under the name "*R*". These values are then stored in the APL workspace●.

workspace: The common organizational unit in an APL system is the workspace. When in use, a workspace is said to be "active", and it occupies a block of working storage in the central computer. Part of each workspace is set aside to serve the internal workings of the system, and the remainder is used, as required, for storing items of information and for containing transient information generated in the course of a computation.

A terminal always has an "active workspace" associated with it during a work session, and all transactions with the system are mediated by it. In particular, the names of "variables" (data items) and "defined functions" (programs) used in calculations always refer to objects known by those names in the active workspace; information on the progress of program execution is maintained in the "state indicator" of the active workspace; and control information affecting the form of output is held within the active workspace.

Inactive workspaces are stored in "libraries"●, where they are identified by arbitrary names. They occupy space in secondary storage facilities of the central computer and cannot be worked with directly. When required, copies of stored workspaces can be made active, or selected information may be copied from them into an active workspace.

ws: Abbreviation for "workspace"●, or shown as "wss" for "workspaces".

WS FULL: "Workspace full"— Error message indicating that the workspace● is filled, perhaps by temporary values produced in evaluating a multiple-step expression, or by values of shared variables.

1. Clear the state indicator
2. Erase unneeded objects
3. Revise calculations to use less space
4. Rewrite application to use external files (TSIO datasets) for data storage

For further information on APL error reports, refer to The APL Language Manual (GC26-3847).
■

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●

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...Are we done?....
...Now, just what should I type to make my stuff "secure"??
The Dot-Dot-Times

The End

...Here comes another *Jot◦Dot Times* Comment Card

Jon McGrew
Kingston APL Support
63CB 003-1, Mail Station 385
IBM Corporation
Neighborhood Road
Kingston, NY **12401**

Reader's Comment Card

We are interested in hearing your comments... and perhaps, so are others. We would like to publish some of the comments in future issues. If you don't want your comments to be published (or if you don't mind them being published but don't want your name to be attached), say so... we'll honor your request. In lieu of such a note, any of the comments will be considered to be fair game for publication.

Time will undoubtedly prevent us from personally responding to very many of the comments that are sent in.

1. **What would you like to see in our future newsletters? [Also, of course, what should we *omit*?] What did you *like* in this one? What did you *hate*?**

2. **What would you most like to see the APL Support group work on; what projects would be the most useful to you?**

3. **Suggestions or comments on anything else:**

—Thank you for your time!

Name _____ IBM Address _____ T/L ____ - _____